THURSDAY, DECEMBER 9, 1880

## BRITISH EARTHQUAKES

ON Sunday evening last week (28th Nov.) the northern parts of the British Isles were slightly shaken by an earthquake. The recent disastrous earthquake shocks in Croatia have called renewed attention to this still mysterious geological phenomenon, and now, while the subject is still fresh and under discussion, a milder visitation of the same nature reminds us that our islands are not wholly exempt from their share in the pulsations of the terrestrial crust. Save the vague and inexact newspaper paragraphs which chronicle the impressions of different observers, we have no information as to the direction of propagation of the earthquake wave of last week, its duration, relative intensity, and angle of emergence at different localities. It appears to have been one of the usual type of earth-tremors experienced in this country, and to have affected the region which, during the present century at least, has been most subject to such movements. It is reported as having been felt at many points in the central valley of Scotland and in the north-east of Ireland, also along the west coast as far north as the further end of the Long Island. Its effects appear to have been most marked over the area occupied by the crystalline schists. In Bute the house-bells rang. At Oban a portion of the plaster was detached from the ceiling of the parish church during the service of the Sunday-school. At Inverary also some plaster was loosened, and a sensation of nausea and giddiness is even said to have been experienced. At Blair Athole the oil in the table-lamps was thrown into undulations, which rose over half an inch up the side of the glass. Over the Lowland belt the effects were less perceptible, though they are alleged to have been distinctly felt as far as Edinburgh. By some observers the duration of the shock was estimated at two, by others at ten seconds. In some places the movement was thought to be from the north-west, in others, from the south-west. One of the phenomena duly chronicled in most of the narratives is the jingling and creaking made by crockery and furniture. Such is the usual meagre kind of detail out of which an explanation of the cause of earth quake movements in Britain is in truth hardly possible.

If we look back into the history of the subject numerous references to earthquake shocks will be found in the annals of the last seven or eight centuries in this country. And if the chroniclers are to be believed, some of these were of exceptional severity. According to the list compiled by Sir John Prestwich, shocks seem to have been specially numerous and severe in the twelfth century. Thus on the 2nd of August, 1134, England was shaken by an earthquake just at the very time that Henry I. was about to take ship for Normandy; "flames of fire burst forth with great violence out of certain riffs of the earth." On another occasion, in the same century, the bed of the Thames was laid bare at London. We read, too, of churches and other buildings having been from time to time thrown down, and of open rents having been left in the ground after the passage of the shock.

In the contemporary records of these phenomena the geologist vainly searches for particulars that may serve to elucidate their origin. He finds much that is doubtfully correct, not a little that is obviously fabulous. Naturally the events were considered merely in their relations to the human population of the country, and those aspects of them were noted that bore special interest in that respect. Most frequently they were regarded in the light of divine judgments, and were connected with some real or imputed delinquency on the part of the inhabitants. We read, for instance, that on the 8th November, 1608, a rather smart shock of earthquake passed over Scotland. In the southern counties it was looked upon as a result of "the extraordinar drouth in the summer and winter before." But the more orthodox worthies in the farther north took a higher view of it. The kirk-session of Aberdeen met, and accepting the earthquake as "a document that God is angry against this land and against this city in particular for the manifold sins of the people," appointed a solemn fast for next day. On further reflection they came to recognise one sin in particular as having doubtless called down the judgment. For more than 150 years, in virtue of a bull granted by Pope Nicolas V., the proprietors on the banks of the River Dee had been accustomed to fish salmon on Sunday. These Sabbath-breakers were accordingly now summoned before the session and rebuked. Some of them agreed to give up their custom, but "some plainly refusit anyway to forbear." Again on 20th October, 1580, an earthquake occurred that particularly affected the house of the Master of Gray. The boy king, James VI asking Fergusson, the minister of Dunfermline, "What he thought it could mean, that that house alone should shake and totter," was grimly answered by the divine: "Sir, why should not the devil rock his awn bairns?"

Doubtless many of the events chronicled in former centuries as earthquakes may not have been of that nature. Landslips and violent storms would account for some of the phenomena recorded. In looking over the lists of reputed earthquakes we cannot fail to notice that some districts of the country have been specially liable to the visitation. One of these has been the south-west of England, embracing the lower basin of the Severn with Somerset, Gloucester, Worcester, Cornwall, and the adjoining counties. Another notable area for a hundred years past has been the southern highlands of Perthshire.

After making every allowance for the vast multiplication of the means of recording passing events afforded by the extension of newspapers and the consequent increasing minuteness of detail in our domestic annals, there seems no reason to doubt that the number of earthquake shocks has increased during the present century, though possibly none may have reached the severity of some recorded in earlier periods. During the four years subsequent to September, 1839, upwards of 200 shocks were felt in Perthshire, some of which extended over nearly the whole of Scotland.

In searching for a possible solution of the problem presented by these terrestrial commotions one or two circumstances should be specially considered. In the great majority of cases where details of any kind have been preserved of the nature of the earthquakes, reference is made to noises that immediately preceded the actual

shock. In not a few instances these seem to have been the most alarming part of the phenomena. They are variously likened to the sound of a rushing wind, the roll of waggons, the muttering of thunder, or the rattle of cannon. With these aërial vibrations there are also recorded sounds as of a sudden snap or blow, or explosion in the earth underneath. Another feature of the earthquake-register is the persistence with which a relation is believed to exist between the commotion in the ground and the state of the atmosphere above. In some cases, indeed, the barometer is said to have suddenly fallen, and then to have risen after the shock had passed. Warm, damp, moist weather, heavy rain, thunder, strange electrical discharges, fire-balls, and other meteoric phenomena are chronicled as the concomitants of earthquakes. It may be said, of course, that the occurrence of these events together is only of the nature of a coincidence, and cannot conceivably be anything else. There can be no doubt, however, that in Britain, as on the Continent, earthquakes have been more numerous in the winter than in the summer half of the year. Of the fifty-nine earthquakes in Sir John Prestwich's list, as Prof. Prestwich has pointed out, eleven occurred in winter, eleven in spring, seven in summer, and eight in autumn. Out of 139 earthquakes recorded as having happened in Scotland up to September, 1839, eighty-nine occurred in the winter half of the year and fifty in the summer half. We cannot suppose that any variation in the meteorological condition of the atmosphere can directly give rise to an earthquake. Nevertheless it is conceivable that where the crust of the earth is in a condition of tension, rapid and extensive changes of atmospheric pressure may destroy an equilibrium that has previously been barely maintained. The observed relation between a low barometer and the more copious escape of fire-damp within coal-mines may possibly be of wider application.

It is evident, moreover, that the source of disturbance must be at no great depth from the surface. This is shown by the markedly local character of the phenomena. A shock of considerable violence which rends walls, overturns chimney-pots, rings bells, shakes furniture, and fills with alarm the inhabitants of a few parishes, but is quite unperceived in the districts around, cannot have a deep-seated origin. In looking at the districts specially liable to such visitations we notice in some degree a connection with geological structure. The earthquake area in the south-west of England embraces within its borders the ranges of the Malvern and Mendip Hills, which, with the surrounding country, point to a long succession of geological disturbances, while the hot springs that still rise there furnish additional indications of a connection between the heated interior and the surface. The most remarkable earthquake district in these islands at present is undoubtedly that of Comrie in Perthshire; where in the month of October, 1839, no fewer than sixty-six shocks were felt, the severest being perceived as far north as Dingwall, and as far south as Coldstream. During the last forty years the British Association has appointed two Committees to investigate the nature of the shocks so frequently experienced there. But their labours cannot be said to have as yet thrown much light on the subject. They have erected seismometers of approved construction and sensitiveness, but in many cases shocks that have been distinctly perceptible to the inhabitants have not been registered by the instruments. Much speculation has been offered as to the cause that earth-tremors should be specially abundant in that district. Reference has been made by different observers to protrusions of granite and dykes of basalt which traverse the rocks, as if these igneous masses supplied a clue to the source of movement. But neither the granite bosses nor the dykes are specially conspicuous in the Comrie district. On the contrary, they are there small in area and few in number compared with their occurrence in other tracts where earthquake shocks are rare. A geological structure at Comrie, however, which so far as we are aware has not been dwelt upon in this connection, is the occurrence there of the great fracture by which the southern edge of the Scottish Highlands is bounded. The Old Red Sandstone with its associated volcanic bands has been thrown on end against the crystalline schists. Of the extent of the dislocation no precise measurements have yet been made; probably the amount of upthrow varies along the line. At the north-eastern end of the fracture the sandstones and conglomerates have been placed on their ends for about two miles back from the fault. The line of dislocation can be traced across the island from sea to sea and across the island of Arran, whence it points for Ireland. It is probably one of the largest, as it certainly is the longest, fracture within the British area. On its north-western side lie the crumpled schists of the Highlands; on its south-eastern boundary are the dislocated, curved, and even inverted strata of the Old Red Sandstone. Two series of rocks of very different structure and elasticity are here brought abruptly together along a vertical or at least steeply inclined face, which must descend for several thousand feet from the surface. So far therefore as geological structure can be supposed to govern the origin and effects of earthquakes there does not appear to be within these islands any line or district where terrestrial disturbances should be so readily felt as along the flanks of the Scottish Highlands. Shocks coming from the Lowlands will recoil against the crystalline wall of the Highland schists, and be consequently more perceptible there than over the more homogeneous formations lying to the south. Another area in which earthquakes have been frequently observed is that of the Great Glen. This longest, straightest, and deepest of British valleys has from early geological times been a line of weakness.

There seems every probability in the supposition that some at least of our earthquakes result from the sudden collapse of rocks that have been under great strain. Their occurrence along lines of powerful fault suggests tha thet rocks on one or both sides of these dislocations are still subject to great tension, and that occasional relief is obtained by a snap which is powerful enough to generate an earthquake, though it gives rise to no change of level at the surface. When we reflect upon the constant strain on the terrestrial crust as it settles down upon the more rapidly contracting nucleus, we may be allowed to be grateful that earthquakes are not everywhere more numerous and destructive.

## THE ENCYCLOPÆDIA BRITANNICA

*The Encyclopædia Britannica.* Ninth Edition. Vols. x. and xi. (Edinburgh: A. and C. Black.)

THESE two volumes of the *Encyclopædia Britannica* fully sustain the high character of the earlier volumes. The articles dealing with branches of physical and natural science are conspicuous by their high quality and number. In geographical science this volume is particularly strong. Dr. Rae contributes an article on "Greece," several specialists contribute the article on "Germany," and General Strachey of the Indian Civil Service has produced a very striking and valuable essay on the "Himalayas." Besides these there are shorter articles on "Greenland," "Grisons," "Guiana," the "Hawaiian Islands," and "Heligoland," all worthy of attention and replete with information. In medical science we note particularly the articles on "Gout," contributed by Dr. Affleck, and on "Heart Diseases" by Dr. G. W. Balfour. In the department of natural history the articles are almost exclusively on subjects of a specific or technical character; Prof. Newton writes on "Grouse," and Mr. John Gibson on the "Hare" and the "Hippopotamus." Prof. Church contributes brief articles on "Hemp" and "Guano," and Dr. Trimen has a good descriptive paper on "Grasses." The article "Herbarium," contributed by Mr. E. M. Holmes, is a remarkably useful and practical handling of a subject on which most botanical writers have usually very little to say; and the summary of information as to the character of the principal herbaria in existence will be found acceptable for reference. The contributions to the physical sciences are numerous and of great interest. Dr. Ball's article on "Gravitation" is at once simple and masterly. The article on "Harmonic Analysis" by the late Prof. Clerk Maxwell is all too short, but admirable in its way. Amongst technical subjects we may single out the articles on "Gunpowder" and "Gun-cotton" by Major Wardell and Prof. Abel respectively, on "Heating" by Capt. D. Galton, two long and very fully illustrated papers by Col. Maitland on "Gunmaking" and "Gunnery," and one on "Harbours" by Mr. T. Stevenson, which is accompanied by several capital plates. Mr. J. Blyth contributes two valuable articles on the "Gyroscope" and on "Graduation." From the latter we miss one or two points that might well have been added. There is no account of the dividing-machine employed by Messrs. Cooke and Sons of York in graduating the circles of the great Newall telescope; nor of the still more recent dividing engine constructed by the Waltham Watch Company. The biographical articles are numerous and excellent. Those on the two "Herschels" are from the pen of Prof. Pritchard. That on "Sir W. Hamilton" is contributed by Miss E. Hamilton. The biographical notice of "Sir W. Rowan Hamilton" is by Prof. Tait, than whom no one is more competent to write of the great mathematician; though somehow we miss in this thoughtful and appreciative article the peculiar characteristics of Prof. Tait's trenchant style. We propose to notice at greater length the important articles on "Geometry," "Geology," and "Heat."

The editor did well, we think, when he intrusted the compilation of the article upon such an important subject as "Pure Geometry" to so accomplished a geometer as Prof. Henrici. We can fancy what such an article would have been in the hands of the generality of English mathematicians trained at our conservative Universities, meek followers, for the most part, of one master: "There is but one Geometry, and Euclid is its exponent." We ourselves entertain a very high regard for Euclid: indeed our indebtedness to him for what ability we may have in geometrical science is as great as that of Cicero to Archias for eloquence; but we cannot help feeling that we might have had a far greater mastery over modern methods had our masters been acquainted with these methods themselves. "This book," says one who has recently left us, a consummate master of modern methods, "has been for nearly twenty-two centuries the encouragement and guide of scientific thought. . . . The encouragement, for it contained a body of knowledge that was really known and could be relied on, and that, moreover, was growing in extent and application. . . . the guide, for the aim of every scientific student of every subject was to bring his knowledge of that subject into a form as perfect as that which geometry had attained." In our author we have one who,

> "Nullius addictus jurare in verba magistri,"

can ungrudgingly acknowledge the many good points of the old-world geometer, whilst, with keen-cutting scalpel, he boldly lays bare his numerous defects. The present generation, perhaps, will not see Euclid superseded in our schools; but when his warmest defender makes him admit that his proofs might be abridged and improved, that alternative proofs may with advantage be appended to his, and that new problems and theorems might be interpolated, we may expect that a time will come, quickly if only the Universities would not handicap their favourite so heavily, when his order and numbering of propositions may be abolished, and his treatment of parallels shelved. In the meanwhile we must work in hope, and the article under notice will possibly pave the way for an improved mode of studying the science. As is well known, Prof. Henrici has long been engaged in writing a Geometry: to this work we must refer readers for his views on the subject. In the *book* we see him as the teacher, laying his foundations deep and strong and broad enough for the vast superstructure—all pure geometry—they have to bear: in the *article*, he treats his subject at first rather as the historian and critic, though subsequently he takes up the *rôle* of teacher again ("use doth breed such a habit in a man"), and rapidly but most deftly sketches a beautiful outline—in parts filled in—of the "higher" geometry. In a long, but far from tedious, sketch of sixty-four columns he treats pure geometry in two sections: the first, in twenty-five and a half columns, gives an account of the Elementary, or Euclidian, Geometry: the second is devoted to the Higher, or Projective, Geometry. In section 1 we have a running commentary on Euclid's text, which does at greater length, though somewhat in the same style, what De Morgan did some years since in the "Companion to the British Almanac" (1849). The axioms which lie at the basis of the subject are well discussed, and their foundation upon experience established: it is pointed out that the connection between these axioms has only been shown "within the last twenty years

through the researches of Riemann and Helmholtz, although Grassmann had already published, in 1844, his classical but long-neglected 'Ausdehnungslehre.'" In this connexion we can merely refer to the admirable lecture by Clifford, "The Postulates of the Science of Space." There is a good statement of Euclid's assumptions, but we shall refer only to that which is made in I. 4, thus enunciated by De Morgan: "Any figure may be removed from place to place without alteration of form, and a plane figure may be turned round on the plane." This is employed by Prof. Henrici, as it has been by many others, to prove I. 5, with this difference, that he does it after Mr. Dodgson has made Euclid say there is "too much of the Irish Bull about it, and that it reminds one too vividly of the man who walked down his own throat, to deserve a place in a strictly philosophical treatise." But the difference between these two writers is a radical one, and is not confined to the above solitary instance. The treatment of Book I. (the remarks on axiom xii. in connection with I. 28, 29 are valuable) calls for no special comment. In Book II. we have the propositions discussed symbolically and proved by the aid of laws investigated by Sir W. Rowan Hamilton and Grassmann: laws familiar to more advanced students, but which are here put in a manner within the grasp, we think, of junior students. The book is one, however, to which this class never take very kindly, and requires patience and illustration on the part of the teacher. We can, from the outline here given, guess how Prof. Henrici will treat this part of geometry in his forthcoming second volume. The remarks upon the Fourth Book conclude with a "few theorems not given by Euclid," but they are readily derived from (if not explicitly stated in) Euclid's constructions. Of Book V. there is a careful sketch, and our author shows "Why the usual algebraical treatment of proportion is not really sound." (Here we may refer also to Mr. A. J. Ellis's "Euclid's Conception of Ratio and Proportion" in his "Algebra identified with Geometry," and in a simpler form in a lecture at the College of Preceptors.) Books VI., XI., XII. need not delay us. We come now to the Projective Geometry, which we should much like to see reproduced in pamphlet form for use in colleges or schools. We notice Prof. Henrici states, "In Euclid's *Elements* almost all propositions refer to the *magnitude* of lines, angles, areas, or volumes, and therefore to measurement." This, too, is our own view, and we presume it is what Mr. Wilson intended when he says: "Every theorem may be shown to be a means of indirectly measuring some magnitude"; whether it be so or not, at any rate Mr. Dodgson cannot impugn the Professor's more guarded statement. Those properties of figures which do not alter by projection are projective properties: there is a slight omission in the illustrations given, an exception should, we think, have been made in the case when the plane of projection is perpendicular to the plane upon which the quadrilateral, or circle, or other figure is projected. The points of difference between the two sciences are well put. "In Euclid each proposition stands by itself; its connection with others is never indicated; the leading ideas contained in its proof are not stated; general principles do not exist. In the modern methods, on the other hand, the greatest importance is attached to the leading thoughts which pervade the whole; and general principles, which bring whole groups of theorems under one aspect, are given rather than separate propositions. The whole tendency is to generalisation." Euclid, it is open to remark, throughout his work, avoids the *infinite*, whereas the modern geometry, like a good Samaritan, takes the most tender care of it. The systems adopted by Prof. Henrici are principally the methods of projection and correspondence—as handled by Von Staudt in the "Geometrie der Lage," and by Grassman in his above-cited work. We should like to analyse this sketch in detail, but we must forbear. For curves of two dimensions it is quite too delicious for us to mar it by such scant and imperfect treatment as we could here give it, and we must content ourselves with giving the heads of the several sub-sections. After the statement of definitions and preliminary explanations, we have segments of a line, projection and cross-ratios (Clifford's name for the anharmonic ratios of Chasles), correspondence, curves and cones of second order or second class, pole and polar, diameters and axes of conics, involution, involution determined by a conic on a line—foci, pencil of conics. The conclusion of the essay on the conics is that we arrive at the definitions from which our English text-books usually start. So the mode of treatment will be seen to be novel to the majority of English students. The concluding sections (six columns) on ruled quadric surfaces, but more especially on twisted cubics, seem to us to bear on their faces tokens of having been somewhat hurriedly written, so are not quite up to the high standard of the previous work. At the close Prof. Henrici refers his readers to Reye's "Geometrie der Lage" for "a more exhaustive treatment of the subject." "Scarcely any use has been made of algebra, and it would have been even possible to avoid this little, as is done by Reye." Prof. Clerk Maxwell, in a note to us, commended, in his own quaint way, this work of Reye. A short list of references is appended.

We could have wished that the "Analytical Geometry" had also been intrusted to Prof. Henrici, more especially that we might have seen how he would have connected the two together, and also that we might have had the subject discussed from a Continental point of view. We have sufficiently comprehensive and good treatises already by English writers, some of which are adorned with much of Prof. Cayley's work, and we feel, too, that had our author had *carte blanche* for space, he would have done his work well; whereas in attempting to pack much matter into a small space we think he has assumed much which is not familiar to some, and yet at the same time which is elementary to others who are advanced students. Nor does the article, to our mind, thoroughly serve for purposes of reference, though, no doubt, it goes some way to this end. The secret may be that "Pure Geometry" is more limited in its range, has, on one side, to do with a book known to almost all, and, on the other side, even does not reach, for the generality, beyond the conic sections; "Analytical Geometry," on the other hand, has to do with everything that relates to curves and surfaces, of whatever sort they may be. Prof. Cayley takes the line of analytical geometry "as a method," and confines himself, in his twenty-four and a half columns, to the consideration of the applications of Cartesian co-ordinates

almost exclusively. The article is divided into the two sections of plane and solid geometry. At the commencement the student is recommended by the weight of Prof. Cayley's advice to trace a number of curves, and he draws a few simple ones, so drawing attention to a point upon which Mr. Frost, in his "Curve-Tracing," strongly insists. Prof. Clifford, too, we believe, had it in his mind to publish an account of some methods which "are exceedingly simple and easy of application; they partake more of the nature of a manual craft than of a purely intellectual occupation, and may so be used as a rest from severer studies; and, as we can only imagine things of which we have seen the like by appealing directly to the senses, they extend those powers of concrete realisation which the growing complication of modern analysis renders daily more desirable." The methods he alluded to are "Projection, a process by which no alteration is made in the order, the class, nor in any other purely descriptive property of a curve;" then "those modifications of form which leave the *order* of a curve unaltered;" then "those changes which exercise no effect upon the class." In the last two cases he proposed to use a process which he used to call "the *composition of curves*, by which a curve of any order or class may be built up out of the simplest elements." We fear that we have lost this proposed sketch, with the many other sketches he had outlined and lived not long enough to endue with a vitality he could so well have given them. After the illustrations referred to Prof. Cayley discusses shortly the metrical theory, and obtains the several familiar equations both in plane and solid geometry. In short paragraphs polar, trilinear, point, and line co-ordinates are described, but not applied. We have noted scarcely any misprints in the first article, but in the second there are several, all of which are easily detected. The figures are very well done.

We would draw attention to the article on Geodesy by Col. Clarke, which we have read with much pleasure. It is well illustrated, and the eighteen columns treat of the following matters:—Horizontal angles, astronomical observations, calculation of triangulation, irregularities of the earth's surface, altitudes, longitude. These are as fully discussed as need be in a sketch of the subject, and we shall expect that Col. Clarke's more extended work on Geodesy, referred to in NATURE, vol. xxi. p. 423, will take its place as a standard work for some time to come.

Geology occupies at the present day so important a position in the circle of the sciences that it deserves to be treated, in any modern cyclopædia, with no niggard hand. A slender essay, confined to a survey of the broad features of geology, would have been sadly disappointing in such a work as the "Encyclopædia Britannica." It is therefore satisfactory to observe that Prof. Geikie, to whom the editor entrusted this article, has put a liberal interpretation upon his trust. He has treated his subject with a fulness worthy of a great and growing science, and worthy too of the noble plan upon which the Encyclopædia has been projected. The masterly article which he has contributed to the new edition stretches over more than 320 columns, and is thus longer than most of the kindred articles, such as those on "Astronomy" and "Chemistry." Possibly it might have borne, here and there, a little condensation, but on the whole it is admirably fitted for its place. It stands forth as a solid and comprehensive monograph which, if reprinted from the Cyclopædia, would form one of the most substantial treatises in our geological literature. But the article is not only substantial, it is, like all Prof. Geikie's writings, eminently readable. The cardina virtues of an encyclopædist are accuracy and conciseness of expression, and he usually finds but little scope for the play of literary graces. Prof. Geikie, however, is far too polished an author to write upon any subject in an unattractive style; and the present article is sufficient to prove—were proof needed—that his graceful pen does not fail him, even when discoursing on the knottiest point in geology. The comprehensive nature of this article, and the originality with which the subject is treated, may be best shown by explaining the seven-fold division adopted by the author. First he deals with the *Cosmical Aspects of Geology*, and not only discusses the shape and the motions of the earth, but stretches his survey to the probable history of the solar system. Then he inquires into the nature of the materials of the earth's substance—an inquiry which falls under the head of *Geognosy*. In the early part of the article the author may seem to trench a little upon subjects which are treated in other articles, but this is almost inevitable in any cyclopædia. It is not to be expected that the several essays shall just touch each other without overlap, like the pieces of a neatly-jointed mosaic. The geognostic division of the article is followed by a section on *Dynamical Geology*, and this in turn by one on *Structural Geology*, or the architecture of the earth. Under the head of *Palæontological Geology* Prof. Geikie sketches the history of life as revealed by the fossiliferous deposits, while in the following section on *Stratigraphical Geology* he traces the chronological succession of events in the history of the stratified rocks. Finally a chapter is devoted to *Physiographical Geology*, or a discussion of the origin of the physical features of the earth's surface.

To see for the first time a great actor play the part of a familiar character is a treat; but the pleasure is seldom quite free from a mixture of disappointment. His reading of the part is usually not our pet and peculiar one, and we are, as it were, bullied into contentment by the great power of the performer. We felt something akin to it when we read the article "Heat" by Sir William Thomson, though the feeling was of course unreasonable. It often happens when for the second time we see a great actor play a great part we yield ourselves to his charm without a trace of intellectual reserve; so it will most likely be when next we read the article "Heat." At all events, the readers of NATURE may be assured that there is little in this article that they can justly find fault with, whatever they may miss to find that they expected. Could it be otherwise, when the author is the pupil of Regnault, the colleague of Joule, one of the patriarchs of the modern science of thermodynamics, the greatest living authority on the theory of heat in Britain? We shall therefore most modestly discharge our function by pointing out to our readers what they will find in Sir William Thomson's article; and by slightly indicating some points on which, to our regret, he has withheld his opinion.

The article opens with a discussion of the sense of heat, and of the distinction between heat and temperature. We are thus introduced to the conception of latent heat, which is explained at some length. The two leading methods of calorimetry, viz. calorimetry by latent heat, and thermometric caloiimetry, are then discussed in general terms; and the results of the comparison of the different calorimetric units by Regnault and others are given. Then follows a full account of the origin of the modern theory of heat, which regards it as energy, and measures it by the equivalent amount of work. We thus have a third method of calorimetry, which is called dynamical calorimetry. Of the thirty-five pages occupied by the whole article eighteen are devoted to thermometry. This is the most important, and certainly the most interesting part of the article. After discussing a theoretical (and to some extent practical) system of thermometry by mixtures of hot and cold water, the thermoscope being the sense of heat in the hand, the author gives an elaborate classification of the different possible kinds of thermoscopes. Then comes an extremely interesting discussion of the merits of the different kinds of thermometers with arbitrary scales. The defects of the mercury-in-glass thermometer, and the advantages which led Regnault to prefer the (constant volume) air-thermometer are fully explained. We do not remember to have anywhere seen so full, and, it is needless to say, so philosophical an account of Regnault's results of the comparison of the different thermometric scales. The rest of the part devoted to thermometry is more or less speculative. The absolute thermodynamic scale of temperature, invented by the author himself, is defined; and its great advantage pointed out, viz., that it gives us a definition of temperature "such that, if a thermometer were graduated according to it from observation of one class of thermal effects in any one particular substance, it would agree with a thermometer graduated according to the same thermodynamic law from the same class of effects in any other substance."

Thermodynamic formulæ are investigated in a variety of cases for graduating thermometers, according to the absolute scale, from experimental data concerning the thermometric substance. A number of instruments are described in detail which are intended to realise these cases in practice. We are thus introduced to the water steam, mercury steam, and sulphurous acid steam thermometers, and the constant pressure hydrogen thermometer. These instruments are mostly new as to their details, and all of them are new in the sense that they have not been practically used hitherto. Nevertheless a great future is predicted for them. It would appear that Sir William Thomson has himself constructed models of them all; but whether he has used any of them in practical work he does not say. It has doubtless occurred to many of our readers, as it has to us, to have doubts and difficulties about thermometric measurements. Nowhere could we find better reasons for our scepticism than in the earlier part of Sir William Thomson's discussion of the systems of thermometry at present in use; we shall look, therefore, with all the greater interest for some farther account of the practical working of these new instruments. Their success, were it even but partial, would be an immense gain to thermal science.

Thermal capacity and specific heat are next defined; and a brief account of the leading features of the results of different experimenters is given, without detail as to the methods employed in obtaining them. For further information we are referred to the articles on "Thermodynamics," "Matter," "Liquid," "Steam." The remaining five pages of the article deal with the transference of heat. Radiation is explained and distinguished from other modes of transference; but to our great regret is dismissed very briefly. A criticism of the work of the various experimenters in this department from an authority like Sir William Thomson would have been most interesting. There is still much doubt and difficulty hanging over the subject of the diathermancy of gases, for instance; we need scarcely mention as an illustration the famous controversy which has raged over water vapour. It may be however that these and kindred matters are to be treated under "Radiation" or "Light"; although we are not referred to these articles. The general principles of the theory of the conduction or diffusion of heat, as laid down by Fourier, are explained; and a most interesting critical account is given of the earlier attempts to measure conductivity. The explanation of the causes of the failure of Clément and Péclet in measuring high conductivities, such as that of copper, is very instructive, and should be closely studied by those engaged in like researches. Of the methods in use for measuring the thermal conductivity (or diffusivity as the case may be) of solids, Sir William Thomson prefers that of Angström, and recommends along with it the use of thermoelectric methods for determining the temperatures along the experimental bar. The mathematical theory of this method is given, and its connection with the researches of Forbes and Thomson on underground temperatures pointed out. The method of Forbes for measuring the conductivities of metals in absolute measure is described in general terms; and the results obtained with it by Tait are given, and compared with those of Ångström and Thalèn. We regret that no mention is made of the recent attempts to measure the conductivities of liquids and gases. The only result given is that of Bottomley for water, and no description of the method accompanies it. It is quite true that the success of many of these attempts has been somewhat doubtful; but, for that very reason, a criticism of the methods by a competent and impartial authority would have been most opportune, and useful as a guide to future experimenters. Appended to the article are a series of ten tables of thermal constants, and a reasoned synopsis of the principal mathematical formulæ that occur in the theory of diffusion. This last is a most valuable part of the article; for it could be given only by a master of the subject, and it is likely to be extremely useful to many physicists, who have sufficient knowledge to enable them to use such formulæ, but not sufficient mathematical power to find them for themselves, or sufficient time to hunt them up from ponderous treatises and half-forgotten memoirs when they want them.

We sincerely congratulate the editor and publishers of the *Encyclopædia* on the high degree of success which continues to attend their great undertaking.

## OUR BOOK SHELF

*Life and Her Children: Glimpses of Animal Life from the Amœba to the Insects.* By Arabella B. Buckley. (London: Edward Stanford, 1880.)

AFTER light came life, and with that life there came its two great functions—growth and development. With the simplest as with the most complex forms there is the same eager race to be run, to increase in size, to multiply, and thus replenishing this earth, to die. "Life and Her Children" is a praiseworthy and admirable attempt to tell us something of the Children that Life sends forth, and of their history. Its main object is to acquaint young people with the structure and habits of the lower forms of life; but in our deliberate judgment it will do a great deal more. None will read its introductory chapter without advantage, and few will read the volume through without enjoyment. Within its narrow limits of 300 small pages no candid reader would expect to find all the details that might be wished for, or all the illustrations that might be desired. What constitutes the book's chief charm is the marvellously simple yet quite scientific style which runs through it, the food for thought and future study which it affords, and the truly philosophic glow which lights up its every page. The volume gives a general account of Life's Simplest Children, the Protozoa. The word "slime" does not seem to us quite a happy term by which to designate the living protoplasm of these creatures; this word conveys the idea of a something adhesive or glutinous, or of a something thrown off a living organism—a something without a structure (sordies, eluvies)—and there seems somewhat of a "contempt for nature," a thought certainly never present in the author's mind, in the use of such a word. Jelly would seem a more appropriate word, as conveying the idea of the consistency requisite for life, and would have the sanction of use. Thus the Noctilucæ, called in this volume "tiny bags of slime," were described, if we mistake not, by their discoverer as "tiny spherical gelatinous bodies," and Prof. Huxley says, "Noctiluca may be described as 'a gelatinous transparent body about the one-sixtieth of an inch in diameter.'"

The chapter on "How Star-fish Walk and Sea-Urchins Grow" is excellent. The story of how the five curious little oval jelly bodies swimming about by their jelly lashes in the depths of the smooth water in some English bay—ended in becoming respectively a lily star, a brittle star, a starfish, a sea-urchin, and a sea-cucumber, is well told, and woodcuts, though they make one see as in a glass darkly, help in their own way to make the meaning plain. In the "Outcasts of Animal Life" a difficult problem is treated of. It need not surprise one that it is not solved. The last four chapters tell of "the Snare-Weavers and their Hunting Relations (spiders)"; the Insects which change their coats but not their bodies, and those which remodel their bodies within cover of their coats; "the Intelligent Insects with Helpless Children, as illustrated by the Ants." This volume thus tells of the greater part of the living invertebrate animals as they are spread over the earth to fight the battle of life. "Though in many places the battle is fierce and each one must fight remorselessly for himself and his little ones, yet the struggle consists chiefly in all the members of the various brigades doing their work in life to the best of their power, so that all while they live may lead a healthy, active existence. The little bird is fighting his battle when he builds his nest and seeks food for his mate and his little ones; and though in doing this he must kill the worm, and may perhaps by and by fall a victim himself to the hungry hawk, yet the worm heeds nothing of its danger till its life comes to an end; and the bird trills his merry song after his breakfast, and enjoys his life without thinking of perils to come. So Life sends her Children forth; and it remains for us to learn something of their history. If we could but know it all, and the thousands of different ways in which the beings around us struggle and live, we should be overwhelmed with wonder. Even as it is, we may perhaps hope to gain such a glimpse of the labours of this great multitude as may lead us to wish to fight our own battle bravely and to work and strive and bear patiently, if only that we may be worthy to stand at the head of the vast family of Life's Children."

The work forms a charming introduction to the study of zoology—the science of living things—which we trust will find its way into many hands. E. P. W.

## LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

### Prof. Tait and Mr. H. Spencer

As Mr. Spencer has already got the length of calling some of my statements "fictions, pure and absolute," it is time that this discussion should cease. But it is necessary that I should at least show my reasons for having made the statements in question. They will be found ample.

Mr. Spencer's pamphlet, which originated this discussion, and in which I am the first subject brought up for vivisection, bears on the title-page that it deals with *Criticisms*.

The only passages of mine which Mr. Spencer quotes, which can possibly have the slightest reference to himself, and which can in any way be construed into criticisms, are but two in number. In these, or in one of them, the cause of his attack on me must be sought.

The first is mainly a verbal transcription from Mr. Kirkman, and as such it is none of mine; but in introducing it I inadvertently (though correctly) spoke of the "Formula of Evolution" as a *definition*.

The second is a passage *from a different part* of my article on Sir E. Beckett's book, and its application is to materialists and agnostics in general.

This latter passage did not appear to me capable of having roused the vivisection-instincts of so calm a philosopher as Mr. Spencer, especially as it was not applied to any one in particular. Of course, then, I at once assumed that the former passage contained the offence which was to be expiated; and I was confirmed in this idea by the way in which Mr. Spencer put his *formula* alongside of the Law of Gravitation. I could not have ventured to suppose that Mr. Spencer "*did not even know that he was in the habit of saying formula rather than definition.*" This *naïve* confession cannot but be correct. Had it been made in Mr. Spencer's pamphlet, I should not have thought it necessary to say a word. It explains at once his frequent entire misapprehensions of my meaning. So I give up my plausible theory of the origin of Mr. Spencer's attack on me; and shall, henceforth, ascribe that attack to my having made a singularly apt and telling quotation from Shakespeare!

With regard to the other parts of the discussion, I feel that I need not add anything to what I have already said; except on one point, an important one.

Mr. Spencer has employed an old remark of Prof. Huxley as to what mathematics can, and cannot, do; but he has not employed it happily, for the question at issue is really this:—Is it correct to speak, at one time, of force as an agent which changes a body's state of rest or of motion, and again to speak of it as the time-rate at which momentum changes or as the space-rate at which energy is transformed?

I answer that there is not the slightest inconvenience here; except, perhaps, in the eyes of those metaphysicians (if there be any) who fancy they know *what* force *is*. Such phrases as "the wind blows," or "the sun rises," though used by the most accurate even of scientific writers, would otherwise (on account of their anthropomorphism) have to be regarded as absolute nonsense. P. G. TAIT

### Geological Climates

It was with great surprise I read Prof. Haughton's unqualified statement in last week's NATURE, that—"It is *impossible* to suggest any rearrangement of land and water which shall sensibly *raise the temperature of the West of Europe*,"—since I had, as I thought, in my recently-published volume—"Island Life"—not only "suggested" such a rearrangement, but also adduced much evidence to show that it had actually occurred throughout the periods when both the West of Europe and the Arctic regions enjoyed a much higher temperature than they do now. I will now briefly re-state my "suggestion," and will also make a few remarks on the general causes of difference of temperature, which may serve to render the subject more intelligible.

It is now well known that places in the temperate zones owe their temperature at different seasons only partially to the amount of direct sun-heat they receive, but very largely to the amounts of heat brought to them by currents of air. Thus we explain, not only the mild winter climate of our islands as due to the prevalence of westerly and south-westerly winds which have become warmed by passing over the Atlantic, but also the wonderful inequality of temperature at different seasons of the year. When we have warm spring-like days in mid-winter, it is because these warm currents of air are passing steadily over our islands; while continued hard frosts are as clearly due to masses of cold air from the north or north-east which drift down to us, often with no perceptible wind. Again, when in April and May we have days as cold as those of December and January, they can always be traced to northerly or easterly currents of air, and are probably often connected with the southern drift of the icebergs at that season. It is clear then, that if south-westerly winds were to continue throughout the winter, the severity of that season would be entirely abolished; and the same effect would be produced if by any means the winds from the north and east lost their severity.

Now the source of the constant warmth of our westerly winds is admitted to be the influx of warm water into the North Atlantic—chiefly by the Gulf Stream; and this warm northward flow of tropical water, being primarily due to the trade-winds, is not confined to the Atlantic, but is equally present in the other great oceans, and similar effects are produced in them, though nowhere to so great a degree as in our islands, owing to our insular position and the great extent to which Europe to the east of us is permeated by water as compared with North America or Asia. The North Pacific, with its great Japan current, is probably quite as warm as the North Atlantic; but Vancouver's Island, though further south than London, has not so mild a climate; and this can be clearly traced to the great mass of land to the east and north of it, the lofty snow-clad mountains, and the absence of those deep gulfs and inland seas which do so much to ameliorate the climate of Europe.

Prof. Haughton states, in his "Lectures on Physical Geography," that the Kuro Siwo, or great Pacific current, is two and a half times as large as the Gulf Stream, while the Mozambique current, which forms the outflow of the warm waters of the Indian Ocean, is one and a half times as much, so that these two currents have together four times the bulk and heating power of the Gulf Stream. If therefore these two currents at any time obtained an entrance into the Arctic Ocean, it is difficult to over-estimate their effect on its climate. The Gulf Stream, of which probably not half passes northwards of our islands, gives to Iceland the same winter temperature as Philadelphia, and keeps the North Cape (far within the Arctic circle) permanently free from ice, and this, notwithstanding the powerful counteracting influences of the lofty Scandinavian mountains on the one side, and the huge ice-clad plateau of Greenland on the other. Suppose that only an equal proportion of the Kuro Siwo entered the Arctic Ocean, is it not probable that no sea-ice at all would form there? While, if Greenland were less elevated and thus ceased to be an accumulator of ice, the combined effect might be to render the whole Polar area free of icebergs. This would at once do away with the chief source of winter cold to all north temperate lands, and ameliorate the climate of America as much, proportionately, as that of Europe.

But we have yet to consider a still more powerful agent in ameliorating the climate of Western Europe in Secondary and early Tertiary times. The heated waters of the Indian Ocean have now no northern outlet, and only penetrate the continent in the sub-tropical Red Sea and Persian Gulf. Now if we suppose the waters of the Bay of Bengal and the Arabian Sea to have had northward outlets through the heart of the Euro-Asiatic continent, penetrating in two or more directions into the then much more extensive Arctic Ocean, we should have an agency at work which would render the presence of any permanent ice in the North Polar area as impossible as it is now in Scotland. The cooling agency of ice being once abolished, the comparatively small area of the Polar as compared with the Tropical seas (about one-tenth) would facilitate the raising of the temperature of the former to perhaps 15° or 20° F. above the freezing point, and this would not only give the Arctic lowlands a climate quite sufficient for the vegetation which we know they supported, but, by doing away with the only source of our winter cold, would give our islands a perfect immunity from frosts and render them capable of supporting the vegetation now characteristic of sub-tropical lands.

That the modifications of land and sea here indicated *did* exist throughout a considerable portion of past geological ages, and that the existing consolidation of the great northern continents, to which the possibility of our present Arctic climates is mainly due, is a comparatively recent and abnormal phenomenon, I have endeavoured to prove in the work already referred to. At present I have only undertaken to show, that a "suggested" rearrangement of land and water adequate to raise the temperature of Western Europe to a very sensible, or even to a very large extent, *is* "possible." ALFRED R. WALLACE

### Photophonic Music

I HAVE not yet met with any reference to the capabilities of the photophone for giving musical harmonies. Might not some curious effects be got in some such way as this:—Suppose a disk perforated with holes in four concentric circles corresponding to the notes of a chord; a beam of light to be sent through each circle to a lens and disk of rubber with tube (as Prof. Bell has described), the four tubes debouching in a cup-shaped cavity to be applied to the ear; lastly, the disk to be rotated variably by means of a small windmill or otherwise. Another arrangement might be to make the beams of light pass through the holes to selenium cells in four telephone circuits, the four telephones being placed in one frame, against which the listener's ear would be put, or coupled in pairs, one pair put to either ear. Again, might not harmonised tunes be obtained thus:—Suppose a broad open drum of wood or cardboard rotated uniformly on a screw forming a vertical axis. The drum is perforated in a spiral band of four lines of holes (for the light), corresponding to the notes of the harmonised air to be produced. This spiral band passes before four rubber disks or selenium cells (as in the former system), but arranged vertically and placed within the drum, at the lower part. The drum, it will be understood, works gradually down the axis, presenting a continuous four-line series of holes before the receiving apparatus. Again, a long continuous strip of cardboard, with four rows of holes, might be passed before the receiver in any convenient way. M.

### The "Philosophy of Language"

THOUGH it is my principle never to answer any criticism of my writings, I find myself obliged to deviate for once from this rule by the character of your highly esteemed review, and by the desire to find a discerning appreciation from your readers, whose judgment has for me the greater value, as it is the main aim of all my works to restore the relations between the science of mind and natural philosophy. Therefore you would oblige me very much by publishing the following short remarks:—

The critic of my *brochure* ("Max Müller and the Philosophy of Language,") says, ". . . Nor is speech the deliberate product of a conscious will." Now it is the real aim of all my works on the philosophy of language to show how the human will—before dark and unconscious—grows to consciousness *by language* and human activity intimately connected with it. Can there be the least doubt of this, even if I refer only to the motto of my "Origin of Language,"—"Language has created reason, before language man was without reason"?

Your critic has made me say *just the contrary of what I really have said*. Besides, it would have been only fair if the critic had pointed to the following little passage of my *brochure*:—

"Max Müller has since expressed *his full assent* to this view," (viz., my theory of the origin of language).

Mayence, November 11 LUDWIG NOIRÉ

[I gladly accept the author's assurance that he adheres to the view that "language has created reason." At the same time his

express words as well as the general bent of his argument seemed to point in the opposite direction. Thus at p. 81 he writes:—"Language is a product of *association*. . . . Language is a product of an active, not of a passive, process; it is the child of *will*, not of sensation." The statement that language is "the child of will" seems to me practically identical with the assertion that "speech is the deliberate product of a conscious will," because the will here spoken of, being "an active process," is necessarily conscious.—A. H. KEANE.]

### Notes on the Mode of Flight of the Albatross

WHEN watching the albatross one is struck with the fact that the bird gets up to windward without appearing to use his wings to a degree sufficient to account for the same. The sailors are satisfied with the explanation that he beats to windward. The conditions are of course not analogous to those of a ship sailing to windward. If the wind be very light, or if there be a calm, occasional powerful and obvious flapping of the wings occurs. If there is no wind, the birds often settle on the water round the ship. In very heavy weather the birds disappear altogether, probably settling on the water. Except that for breeding they resort to the islands, I believe they frequent the open ocean, where the surface is seldom without more or less swell.

On watching the flight of the albatross, one observes that in order to rise from the water violent and obvious flapping of the wings is necessary, which is continued some time after the wings cease to strike the water. After a start has thus been effected, if there is a fresh breeze, the wings are kept almost motionless. Sometimes the bird goes some distance with the impetus derived from the flapping of the wings at the start, but sooner or later he turns so as to expose the plane surface of his wings full to the force of the wind, rising at the same time some height above the water, and drifts off to leeward, thus soon acquiring the velocity of the wind; then swooping down into the hollow between two swells, he turns his head to windward, and keeping close to the surface of the water, sails along more or less against the wind for a surprising distance; finally, rising over the crest of a wave comparatively high into the air, and turning with his wings as before, so as to catch the wind to the fullest extent, he again lets himself drift off to leeward.

Thus the manœuvre he performs seems to consist in drifting with the wind in such a way as to attain its velocity very soon, and then turning round so as to make use of this velocity to carry him in the contrary direction.

Of course if he still remained exposed to the wind which had imparted to him its velocity he would not travel far against it before he came to a standstill, and he would certainly make no progress to windward; but by keeping close to the surface of the water, and as much as possible in the hollows between the waves, he is almost out of the wind; and in this comparatively calm region the impetus derived from the wind will carry him a long distance in exactly the opposite direction to that of the wind itself.

This manœuvre appears to be an important factor. No doubt the almost imperceptible movement of the wings may assist, though that this alone is insufficient to account for the progress to windward appears evident from the powerful efforts made with the wings in rising from the water and in calm weather. I have never had an opportunity to observe the albatross flying over land or over level water. If the manœuvre above described be an important factor, the birds then would have to use their wings much as they do in very light winds on the ocean. If very strong winds were blowing, they would have to settle on the land or in the water in order to remain at the locality.

ARTHUR W. BATEMAN

### A General Theorem in Kinematics

PROF. EVERETT (*ante*, p. 99) has overlooked in the introductory paragraphs of Prof. Schell's paper, to which he refers for the original statement of the theorem re-discovered by Prof. Minchin, the acknowledgment: "Der Mittelpunkt der Beschleunigungen und jene beiden Kreise wurden bereits 1853 von BRESSE gefunden." The reference is to the *Journal de l'École Polytechnique*, tom. xx., "Mémoire sur un Théorème nouveau concernant les Mouvements Plans, etc." By means of the "two circles" Bresse determines the point $c$ ($J$) "qui aura une accélération totale nulle" (p. 82), and then by very ingenious application of kinematic principles deduces those relations to it which any arbitrary point ($P$) has, as given by Prof. Minchin. Bresse names $c$ "second centre instantané de rotation."

University Hall, December 4

J. J. WALKER

### Geometrical Optics

YOUR correspondent "P. C." (NATURE, vol. xxii. p. 607) asks information concerning a work, in English or French, on geometrical optics, thoroughly explaining the optical construction of telescopes and microscopes. I am not aware of any such publication these last forty years, but deem it possible that it may interest your correspondent to know of the existence of such a work in German by von Littrow, entitled "Dioptrik, oder Anleitung zur Verfertigung der Fernröhre." It was published, I believe, in Vienna about 1838.

W. G. LOGEMAN

High Burghal School, Haarlem, Holland, November 17

[Littrow's "Dioptrik" was published at Vienna in 1830 in 8vo.—ED.]

### Ozone

IF a slip of the prepared paper, used for testing for atmospheric ozone, be carefully moistened on one side with alcohol, using a clean camel-hair brush, on burning off the spirit and immersing the slip of paper in water the paper changes to a deep purple colour, as deep as No. 8 in Negretti and Zambra's scale of colours for ozone.

Is this due to the development of ozone? as, according to Schönbein, heat destroys ozone.

J. P.

Leicester, December 5

## PLANTS OF MADAGASCAR

DURING the present year no less than four separate collections of plants have been received at Kew from Madagascar, including in the aggregate about a thousand species, represented by specimens complete enough to be botanically determinable. As the hills of the interior of the island attain an elevation of 10,000 feet, its range of climate is considerable. We now know not less than two thousand Madagascar flowering-plants, and probably have almost exhausted its ferns, to which the collectors have paid special attention, and which are about 250 in number, so that we may consider ourselves in a position to draw broad general conclusions as to the botany of the island.

Amongst the tropical types there are a considerable number of endemic genera. The lemurs find their parallel in the vegetable kingdom in the *Chlænaceæ*, a natural order whose nearest affinities are with *Tiliaceæ*, *Dipterocarpeæ*, and *Ternstromiaceæ*, which is strictly confined to Madagascar, and comprises four genera and about twice as many species, to which the Rev. R. Baron, in these new collections, has added a well-marked novelty in a second species of *Leptolæna*. Altogether there are certainly not less than fifty genera confined to the island, some of them very curious types, as *Dicoryphia* in *Hamamelideæ*, *Ouvirandra* in *Naiadaceæ*, *Asteropeia* (placed in the "Genera Plantarum" in *Samydaceæ*, but which Mr. Baron's excellent new specimens will most likely have to be removed to *Linaceæ*), *Macarisia* in *Rhizophoreæ*, *Deidamia* and *Physena* in *Passifloreæ*, *Hydrotriche* in *Scrophulariaceæ*, *Canetia*, *Tánnodia* and *Sphærostylis* in *Euphorbiaceæ*, *Pachnotrophe* in *Moreæ*, *Calantica* in *Samydaceæ*, and several each in the orders *Rubiaceæ*, *Melastomaceæ*, and *Compositæ*. To these endemic types the new collections add at last three, *Kitchingia*, a fine new genus of *Crassulaceæ* allied to *Bryophyllum*, with five or six species named after the collector of the first of the four parcels, *Rhodocodon*, a monotypic genus of gamophyllous *Liliaceæ* allied to *Hyacinthus*, and *Micronychia*, in *Anacardiaceæ*, also monotypic, figured lately in Hooker's Icones. Besides these the tropical flora of the island contains a large proportion: first, of endemic species of genera known elsewhere; second, of species

common to Madagascar, Mauritius and Bourbon, but not elsewhere known, such as *Pittosporum Senacia*, *Aphloia mauritiana*, *Gouania mauritiana*, *Nesæa triflora*, *Lobelia serpens*, and *Buddleia madagascariensis*; thirdly, of species that spread across Tropical Africa, such as *Haronga paniculata*, *Desmodium mauritianum* and *oxybracteum*, *Gynura cernua*, *Brehmia spinosa*, and *Mussoenda arcuata*; fourthly, of species spread universally through the tropics of the Old World, but not reaching America, such as *Crotalaria stricta*, *Oxalis sensitiva*, *Nymphæa stellata*, *Trichodesma zeylanica*, *Indigofera enneaphylla*, *Avicennia officinalis*, and *Rhizophora mucronata*; and fifthly, of species spread universally through the tropical zone of both hemispheres, such as *Eleusine indica*, *Tephrosia purpurea*, *Drymaria cordata*, *Elephantopus scaber*, *Terammus labialis*, *Zornia dephylla*, *Waltheria americana*, *Sida rhombifolia*, and *Nephrodium molle*. In Mauritius and the Seychelles there are 145 species which occur also both in Asia and Africa, in addition to 225 which are spread all round the world in the tropical zone, and nearly all these 370 species are now known in Madagascar also. A small proportion of the Madagascar genera and species are Asiatic but not African, and these present collections add to the island flora *Lagerstromia*, *Buchanania*, and *Strongylodon*, three well-marked Indian types.

But perhaps still more interesting, in the light that it throws on the past history of the island, is the relationship of the comparatively limited flora of the mountains of the interior to that of other parts of the world. A certain number of the plants, especially the ferns and fern-allies, are widely-spread temperate species, which now have their head-quarters in the temperate regions of the northern hemisphere; we have instances of this in *Nephrodium Filix-mas*, *Aspidium aculeatum*, *Osmunda regalis*, *Lycopodium claratum*, *L. complanatum*, *Sanicula europæa*, *Potamogeton oblongus*, *Sonchus asper*, *S. oleraceus*, *Polygonum minus*. Most of the characteristic types of the Cape flora are represented on the Madagascar mountains, but nearly always by species which are distinct from those which are now found in the extra-tropical regions of the main continent: for instance, the Aloes by a couple of species of *Eualoe*; the Heaths by several species of *Philippia* and *Ericinella*; the bulbous Iridaceæ by species of *Gladiolus*, *Geissorhiza* and *Aristea*; the saprophytic *Scrophulariaceæ* by *Harveya obtusifolia*; the special Cape ferns by *Mohria caffrorum*, *Cheilanthes hirta*, *Pellæa hastata*, and *P. calomelanos*; the Proteaceæ by the curious genus *Dilobeia* (which Du Petit Thouars found at the beginning of the century, and of which Dr. Parker has now sent home the first specimens which have been seen in England); and the *Selagineæ* by *Selago muralis* of Bentham, which grows in the grounds of the Queen's palace at Antananarivo. But perhaps the most interesting feature of all is the occurrence of several striking cases of specific identity between plants of the Madagascar mountains and those of the tropical zone of the African continent. The only Madagascar violet (*Viola emirnensis*, Bojer, = *V. abyssinica*, Steud.) only occurs elsewhere high up amongst the mountains of Abyssinia, at 7000 feet above sea-level in the Camaroons, and at 10,000 feet above sea-level at Fernando Po. The only Madagascar Geranium (*G. emirnense*, H. B. = *G. compar*, R. Br. = *G. simense*, *latistipulatum* and *frigidum*, Hochst.) has a precisely similar area of distribution. *Caucalis melanantha* of Bentham is only known in Madagascar and amongst the mountains of Abyssinia. The Madagascar *Drosera* (*D. madagascariensis*, D.C. = *D. ramentacea*, Burch.) reappears at the Cape and the mountains of Angola and the west tropical coast; *Agauria salicifolia*, Hook. fil., which we noted lately as having been gathered by Mr. Thomson on the high plateaux of Lake Nyassa, is found in the Cameroons and on the mountains of Madagascar, Mauritius, and Bourbon; *Crotalaria spinosa* reappears in Nubia, Abyssinia, Angola, and Zambesi-land; *Asplenium Mannii*, Hook., on the mountains of Zambesi-land, the Cameroons, and Fernando Po. As a whole, it would seem that the flora of the Madagascar mountains corresponds closely with that of the great ranges of the tropical zone of the main African continent.

J. G. BAKER

## BENJAMIN COLLINS BRODIE, BART., F.R.S., D.C.L.

ON Wednesday, November 24 last, died Benjamin Collins Brodie the younger, a worthy son of a distinguished sire. Born to affluence, but early imbued with the liberal and high-minded views of the great surgeon, he determined to devote his life and energies to the prosecution of science for its own sake, and well has he done his work. Brodie was born in London in 1817, and educated first at Harrow under Longley, and afterwards at Balliol, taking his Master's degree in 1842. In those days it was absolutely impossible to carry out original chemical work at Oxford, and Brodie naturally betook himself to Giessen, where Liebig's name drew students from all parts of the world. There in the summer of 1845 Brodie, at Liebig's suggestion, carried out analyses of certain waxes obtained by Gundlach by feeding bees on different kinds of sugar. The results thus obtained led him to continue his examination of bees'-wax on his return to England, and from his private laboratory in the Albert Road now came forth his well-known researches on the Chemical Nature of Wax (*Phil. Trans.* 1848, 147-170; 1849, 91-108), for which in 1850 he received the well-merited reward of the Royal Medal. These researches will always remain not only remarkable as having given a successful solution of a difficult problem, but as having proved, by careful preparation and exact analysis, the existence in wax of solid bodies which play the part of alcohols, and of which common spirit of wine is a direct lineal descendant. This unexpected discovery of solid alcohols containing respectively twenty-seven and thirty atoms of carbon in the molecule completely confirmed the truth of the views concerning the existence of an homologous series of alcohols first enunciated by Schiel and Gerhardt, and thus placed in firm position one of the chief pillars of the organic portion of our science.

Brodie's next work was not inferior either in importance or in workmanship to his first. In 1850 he published his memoir "On the Condition of certain Elements at the Moment of Chemical Change" (*Phil. Trans.*, 1850, 750-804), in which he carefully investigates the remarkable reducing action exerted by peroxide of hydrogen. Not only does this body lose half its oxygen when brought in contact with oxide of silver, but reduces this oxide to metal. This anomalous action was satisfactorily explained by Brodie, who pointed out that the second atom of oxygen in these peroxides is not only retained in an unstable state of combination, but that when brought into contact with silver oxide a true synthesis of oxygen occurs, two atoms of this element uniting to form one molecule of free oxygen. That this reaction really takes place was shown by Brodie to be the case by careful experiment. These results led him to consider the constitution of the alcohol radicals (*Chem. Soc. Journ.* iii. 405), and to assert in 1851 the important fact, now universally admitted, that the molecule of the radical ethyl contains four atoms of carbon. To him too we owe the prediction of the possibility of the existence of the mixed radicals, a prediction so soon afterwards experimentally verified by Wurtz. Next we find him active as secretary of the Society of which he afterwards became president, viz. the Chemical Society of London; also in lecturing at the Royal Institution on the allotropic changes of certain elements, on the formation of hydrogen and its homologues, in which

he clearly brings forward his views concerning the union of atoms to form the molecule.

In 1853 he published his interesting observations on the conversion of yellow phosphorus into the red modification by heating it to 200° in presence of mere traces of iodine (*Chem. Soc. Journ.* v. 289). Another very important and difficult investigation which occupied much of his attention about this time was the question of the purification (*Ann. de Chimie*, 45, 351) of graphite, and the determination of its "atomic weight" (*Phil. Trans.* 1859, 249). By heating graphite with strong nitric acid and chlorate of potash, Brodie showed that, unlike all the other modifications of carbon, graphite yields a remarkable crystalline acid, to which he gave the name of graphitic acid, having the formula $C_{11}H_4O_5$. The existence of this interesting body led Brodie to the conclusion that graphite may be considered as a peculiar radical, to which he gave the name of graphon. In the year 1855 Brodie was appointed Waynflete Professor of Chemistry in the University of Oxford, a position which enabled him to throw all his influence into forcing the recognition of chemical science as a proper object of academic training. Under his fostering care the science which had hitherto been so long neglected put out distinct signs of life: new laboratories and lecture-rooms were built, to which students flocked in numbers, and Oxford saw the unwonted sight of her professor of chemistry busily engaged in original investigation, as well as in the tutorial duties of his chair. The discovery of those singular and dangerous bodies, the peroxides of the organic radicals (*Proc.* Roy. Soc. ix. 361, *Phil. Trans.* 1863, 407), was made in the laboratory of the New Museum. The same laboratory soon afterwards saw the minute and careful investigation on ozone (*Phil. Trans.* 1872, 432), which proved beyond doubt or cavil that the supposition that the molecule of ozone is represented by the formula $O_3$ is both necessary and sufficient to explain all the observed phenomena.

Next we find him experimenting on the synthetic production of the hydrocarbon methane, as well as of formic acid, by the direct union of hydrogen and carbon monoxide under the influence of the electric spark. Then he examines the effect of an induced electric current upon pure and dry carbonic acid, and proves that this gas is partially decomposed with formation of carbon monoxide and oxygen, the latter gas being converted into ozone. And he then proceeds to ask whether the ozone thus produced is identical with that obtained from ordinary oxygen, and by a series of careful quantitative experiments demonstrates the identity of the ozone from these two sources.

This was Brodie's last experimental investigation. Ere long he resigned the Chair of Chemistry at Oxford, regretted by the whole University. He retired to his charming seat on the summit of Box Hill. Neither his own scientific activity nor his deep interest in the scientific work of others ceased on his withdrawal from professional life. Before his retirement he had put forward (*Phil. Trans.* 1866, 781-860) in his "Calculus of Chemical Operations," views altogether novel respecting the nature of chemical change. In place of the usual mode of considering this as due to a change in the relative positions of the atoms of which matter is composed, Brodie founds his theory of the constitution of chemical elements and compounds on the simple volume-relations discovered by Gay-Lussac to exist between these substances in the gaseous state. To hydrogen Brodie gives a simple symbol, because the unit of hydrogen can, as he expresses it, be conceived as made at once by one operation, whilst to oxygen he gives a double symbol, because it cannot, according to him, be made by less than two operations. The element chlorine is supposed to be made up of three operations, and a treble symbol is given to this body. Concerning the probable or possible decomposition of the elements Brodie naturally speculates. His analysis had led him to suspect that "chemical substances are really composed of a primitive system of elemental bodies analogous in their general nature to our present elements, some of which we possess, but of which we possess only a few" ("Ideal Chemistry," p. 54). But no experimental evidence of this fact was offered by him, and none of a satisfactory character was otherwise forthcoming, until Victor Meyer announced his belief that chlorine was capable of undergoing decomposition at high temperatures.

Here was a proof of the truth of Brodie's complex symbol! Sad to say, further experiment has not corroborated this conclusion. No substance differing essentially from chlorine has yet been got from this body. Even the change of density at a white-heat appears in the case of chlorine to be, to say the least, doubtful. So we are left for the present, and the author of the "Calculus of Operations" is left for ever, without the experimental confirmation of his conclusions which he so much desired. Whatever may be the verdict of the future as to the value of Brodie's Calculus, there is no doubt that science is indebted to him for an altogether new view of chemical combination obtained by a systematic analytical process.

This occasion is not a fitting one to enlarge upon the high personal character of the late Sir Benjamin Brodie. Suffice it to say that in all relations in life, in the domestic circle as in society, in the chair at Burlington House as in that at Oxford, he displayed all those qualities of heart and head which alone give dignity and sweetness to life, the possession of which ensures for his memory a lasting place in the minds of all those who were fortunate enough to count him amongst their friends. H. E. R.

## THE PHYLLOXERA IN FRANCE

THE new vine-disease, due to the *Phylloxera vastatrix* Planchon, has already caused much damage to the French vineyards and wine-production. From the taxes arising from that national industry France derives a considerable part of her revenue; and this subject has consequently occasioned innumerable publications and investigations. Of the latter some have been empirical and without result; others, which were conducted scientifically, have alone been of any use. It was moreover absolutely necessary to have an unswerving confidence in exact observations, in order to persevere in making experiments which are often disturbed and rendered apparently self-contradictory by the secondary and ever-varying conditions of cultivation. These experiments have at last been crowned with success, and now there are decidedly good grounds for hope. For the last two years the public have shown a steadily increasing confidence in scientific methods.

One of the most distinguished chemists, a man of whom France is proud, and with whom readers of NATURE are well acquainted, especially as they were lately presented with his portrait and biography, M. Dumas, applied himself to the study of the Phylloxera, and pursued his task from day to day with keen determination, notwithstanding the attacks of some and the discouraging advice of others. It is his well-intentioned and unceasing diligence that we must thank for never having lost heart; it is to him that those results are due which are presently to be indicated. When the pébrine-disease was raging on silkworms in the South of France, it was by his personal suggestion and repeated encouragement that M. Pasteur agreed to devote himself to that difficult study; and it is the same gentle influence and guidance that have directed the present writer, together with several others, especially MM. Balbiani, Duclaux, and Mouillefert.

Henceforward the principal problems raised by the study of vine diseases are solved. They were solved one after another in regular order, as fresh light appeared and the ends to be aimed at became more definite. It cannot

be too frequently repeated that that is due, not to a happy hit or to guess-work, but to an unceasing and skilfully conducted struggle which was kept up with indomitable persistence in the midst of obstacles caused by many selfish interests. Times are greatly changed since M. Dumas[1] protested, in discreet but unmistakable language,

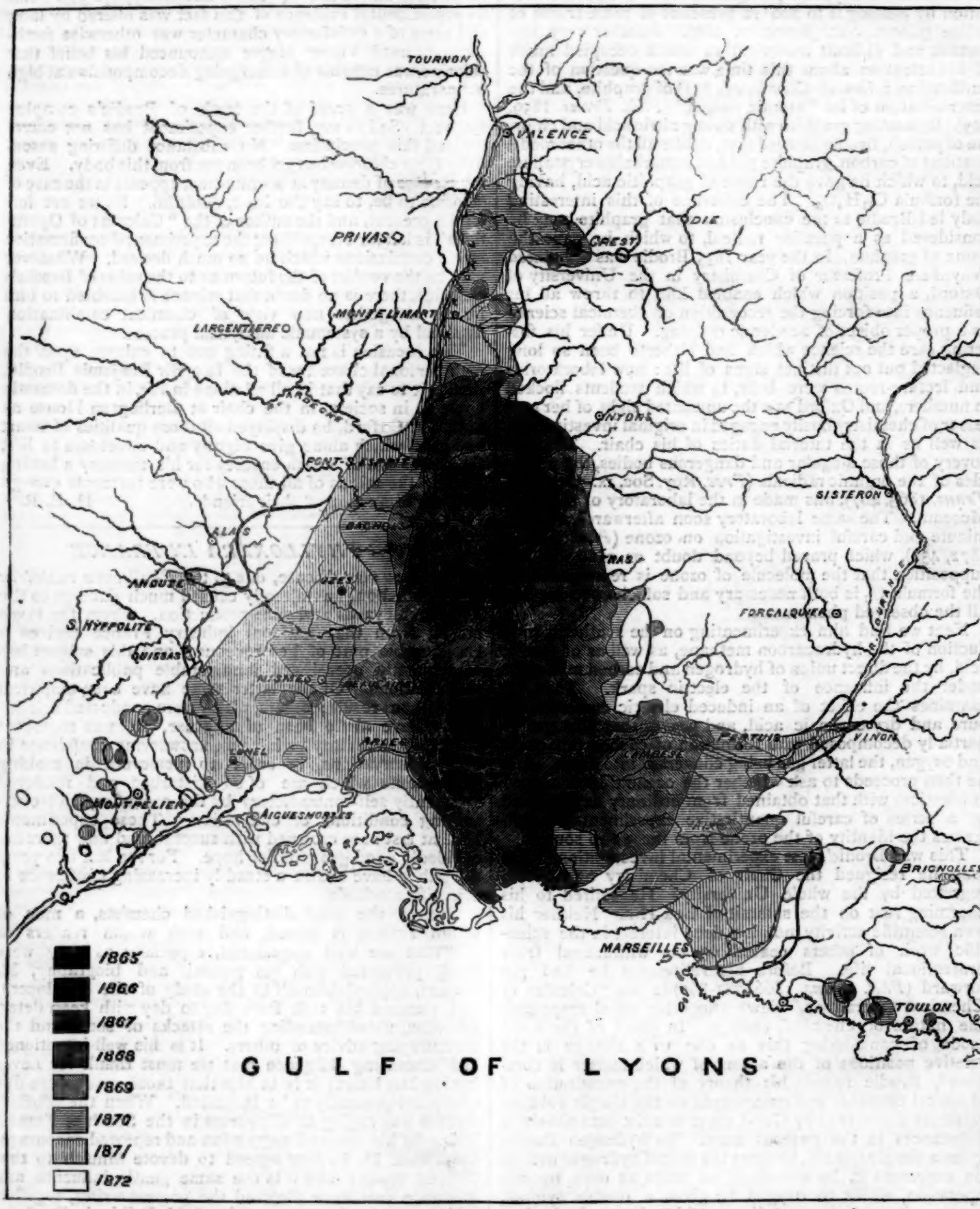


FIG. 1.—Map showing the spread of Phylloxera in France from 1865 to 1872. (See NATURE, vol. x. p. 504.)

against the indifference of a French Minister of Agriculture who tried to beat down a grant of 10,000 francs necessary for continuing the scientific investigation. On the same occasion he drew attention to the praiseworthy initiation taken by the railway companies and by various private gentlemen. M. Tirard, the present Minister of Agricul-

[1] Académie des Sciences, February 23, 1874.

ture, has obtained several large grants,[1] and proposes to ask still much larger ones for the approaching campaign, being anxious to assist in every way the laborious struggle. M. Tisserand, the new Director at the Office of Agriculture, a man of great energy and ability, has resolved to back up all his efforts, and has instituted a special central staff to take charge of all documents and operations. The Higher Phylloxera Commission, formed by order of the Minister, has also shown activity: it has adopted a general legislative scheme in order to supply the Government with the arms necessary to defend the threatened territory.

Switzerland and Germany soon adopted similar measures; and with reference to England we must remark that the Phylloxera question may soon become something different from a mere matter of curiosity. Are there no important vineyards in England? We are told that at Liverpool alone, in the "Vineries," there are forty hectares of vines grown under glass. The Phylloxera was observed by Mr. Westwood before it was known in France. It is still found here and there in Ireland, in Scotland, and not far from London itself. By the admirable cultivation under glass, in which English vine-growers are unrivalled, it is kept within narrow limits, but it might

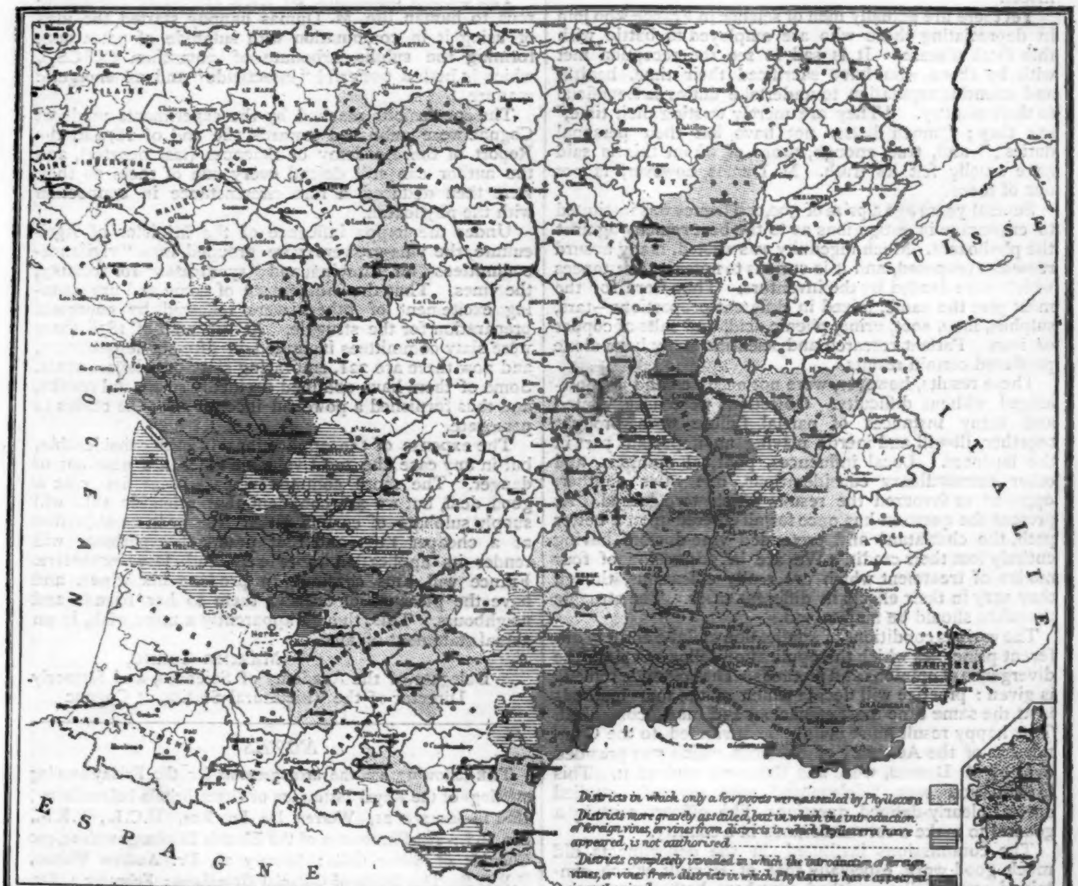


Fig. 2.—Map showing the spread of Phylloxera in France up to 1880.

be communicated to other places. In Switzerland one single parcel of plants is reported to have brought the parasite to Geneva, Schaffhausen, and Neuchâtel. In any case, should an international convention be instituted, the enforced examination at the frontiers would hamper the trade in those magnificent English grapes. The rigorous measures taken against the cattle-disease suffice to show what may be necessary in order to defend the leaf or shoots of the vine.

*Extent of the Disease.*—The increase of the disease is considerable; thus at the beginning of 1877 there were only twenty-eight departments attacked, whereas at the beginning of 1879, according to the official statistics, there were thirty-nine. Those in the previous year, in order of date,[1] were Loir-et-Cher, Haute-Garonne, Gers, and Corrèze. In 1878 Aude, Pyrénées-Orientales, Haute-Loire, Vienne, Indre, Côte-d'or, and Savoie. In 1879, Haute-Savoie, Jura, Arriège, and Tarn. A special inquiry enables us to determine what area had been invaded in the end of 1879:—the invaded vineyards which had not yet succumbed were 319,760 hectares in

[1] One of 500,000 francs, which has since been doubled.

[1] "Le Phylloxéra, &c.; Rapports publ. par le Ministère de l'Agric." 8 fasc., p. 9. (Paris: Masson, 1879.)

extent, or 76,722 more than the preceding year; the vineyards destroyed, 474,760; or 101,317 more than the preceding year (1878).

There is unfortunately reason to fear that the isolated points may join each other and the affected patches unite. The patches, whether distinct or uniting, increase about 15 kilometres every year; and since the increase in any direction is proportional to the time, the increase of area is as the square of the time. In other words, after 2, 3, 4, 5 years, the evil is increased 4, 9, 16, 25 times. By merely looking at a map showing the extent of the plague, one can form an idea of the invading march of the terrible insect.

Yet there are actually men of science in France who join in depreciating those who are employed to battle with this fatal disease. It is sad to see the reception met with by those who have sacrificed their time, health, and scientific reputation to undertake duties so beneficial to their country. "They are merely wasting their time," say they; "much better not have left their personal duties;" and, true enough, those of whom this is said have cruelly felt its truth. M. Dumas, however, is not one of those.

Several years ago a prize of 300,000 francs was instituted to encourage investigations as to the best remedy against the phylloxera. Much ingenuity was wasted, many absurd remedies proposed, and it is curious to note the substances which were lauded by the inventors. They were for the most part the same, mixed in different proportions—tars, sulphur, lime, soot, urine, phenic acid, and salts of copper or iron. Patient research and scientific study have alone produced certain results.

These results, however, were not accepted and acknowledged without difficulty. Objections were accumulated and many instances of partial failure were brought together, ill-will and inertia playing an important part in the business. Local influences, political opinions, and other extraordinary considerations, one after another, opposed or favoured the results which were gained. At present the question has once for all entered upon a better path, the charlatans and pretended vine-doctors having entirely lost their credit. We are in possession of four modes of treatment which are really efficacious, though they vary in their effects in different cases. The struggle therefore should be maintained.

The various conditions of application and the entirely different principles which the application follows explain the divergence of opinions and methods. The scientific remedy is given: practice will decide which of the four methods is at the same time most efficacious and most economical. This happy result must mainly be attributed to the Commission of the Academy of Sciences, which was presided over by M. Dumas, who was the very soul of it. This Commission sent "delegates," who severally studied special clearly-defined questions, like officers sent by a general to make a reconnaissance in a country.

The commissions instituted in the departments did much good work, especially that of Hérault, which contained several distinguished members, both vine-growers and scientists: MM. Marès and Planchon, Members of the Institute of France; M. Bazille, Senator; M. Vialla, &c. We must also notice particularly the Viticultural Station at Cognac, which was established by private subscription, after the English manner,—a thing of rare occurrence in France. It was M. Lecoq de Boisbaudran, now Member of the Institute, the discoverer of the metal *Gallium*, who first started the idea, and triumphantly realised it in his native town. The principal houses in the trade made it a point of honour to subscribe, and the expenses in four years reached a sum not less than 32,000 francs. It was there that the general experiments as to "insecticides" were made, in accordance with the simple method proposed by M. Cornu, Director of the Viticultural Station, in order to determine definitively what substances are powerless. This work of "clearing the way" necessarily occupied several years, the practical part being energetically carried out by M. Mouillefert, of the National School of Agriculture at Grignon, near Paris, sub-director of the Viticultural Station. Towards the end of the first year they began to distinguish clearly the small group of substances which alone should be utilised. Amongst them was carbon disulphide ($CS_2$), which had been indicated by Baron Thénard, abandoned and then eagerly resumed by the enthusiastic M. Monestier, and at last rejected in a general manner in the end of 1873 and during 1874.

The carbon disulphide by itself appearing too dangerous to human life, M. Dumas happily started the idea of using it in combination with sulphide of potassium, forming the sulpho-carbonate of potassium ($KSCS_2$), which is both a powerful "insecticide" and an energetic manure.

The conclusions reached by the experiments made at Cognac were published towards the end of 1874 in the Report of the Academy of Sciences (last quarter), and the author can still defend every one of them as they were then deduced, a rare circumstance in connection with the phylloxera.

Under the happy influence of the Minister of Agriculture, the vine-growers were grouped into "vigilance-committees" for watching, and "syndicates" for treating, the vines. Thus the indifference of some and unreasoning excitement of others were followed by energetic preparation for the struggle. At the end of 1878 there were sixty committees instituted in fifty-six departments, and now there are 221, embracing sixty-one departments. Some of them have obtained decidedly successful results, and thus furnished a powerful incentive for the others to persevere.

The expense of the applications is still considerable, but in any case the most valuable vines are now out of danger. The more common vines will at first cost a good deal, but we are confident that scientific skill will supply sulphate of carbon either free or in combination at a cheaper rate, and that practical experience will render its application more easy and less expensive. France will thus continue to produce her wines, and have the pleasure of offering them to her friends and neighbours. This, though apparently a mere wish, is an actual statement of fact.

MAXIME CORNU,
Delegate of the Academy of Sciences, and formerly Director of the Viticultural Station at Cognac

## NOTES

THE following are the arrangements for the Friday evening meetings of the Royal Institution of Great Britain before Easter, 1881:—January 21, Warren De La Rue, D.C.L., F.R.S., Sec. R.I., The Phenomena of the Electric Discharge with 14,400 Chloride of Silver Cells; January 28, Dr. Andrew Wilson, F.R.S.E., The Origin of Colonial Organisms; February 4, Dr. Arthur Schuster, F.R.S., The Teachings of Modern Spectroscopy; February 11, Robert S. Ball, LL.D., F.R.S., The Distances of the Stars; February 18, Sir John Lubbock, Bart., M.P., D.C.L., F.R.S., M.R.I., Fruits and Seeds; February 25, Dr. J. S. Burdon-Sanderson, LL.D., F.R.S., Excitability in Plants and Animals; March 4, Sir William Thomson, LL.D., F.R.S., Elasticity viewed as Possibly a Mode of Motion; March 11, uncertain; March 18, Wm. H. Stone, M.D., Musical Pitch and its Determination; March 25, Alexander Buchan, M.A., F.R.S.E., Sec. Met. Soc. Scot., The Weather and Health of London; April 1, uncertain; April 8, Prof. Tyndall, D.C.L., F.R.S., M.R.I.

THERE is nothing that will tend to keep our learned societies in so wholesome a condition as healthy public opinion; it is

therefore a matter for congratulation when we see a paper like the *Times* taking an interest in the organisation and work of the Royal Society, and giving its opinion on these, even when the justice of that opinion is questioned by many. From a leading article in the *Times* of Thursday last, on Mr. Spottiswoode's address, we take the following passage:—"The election to the vacancies in its ranks has of late years been too manifestly governed by a tendency to set up as an idol something which it is technically fashionable to call 'research,' and to ignore the far higher mental effort which is required for successful ratiocination. A man sets to work with a microscope and a test-tube, performs a number of curious experiments, and announces an interesting discovery which can neither be confirmed nor refuted by any one who does not follow precisely in his tracks. Such an experimenter, before now, has been rewarded by the privilege of placing the letters F.R.S. after his name; although, when the privilege had been conferred beyond recall, it may have been shown that his 'research' was undermined by the neglect of some essential precaution, and that his conclusion was erroneous. On the other hand, the man who gathers up the scattered facts ascertained by others, and founds upon them a weighty and important generalisation, is not on that account thought worthy of the Fellowship; and if he desires to obtain it is almost compelled to engage in some colourable 'research' as a means of gratifying his wishes. The principle thus acted upon is as much a mistake as it would be to glorify a carpenter or a mason and to ignore an architect; and it points to a narrowness of view which might profitably give place to a more accurate sense of relative proportion. The award of a medal to Prof. Lister, notwithstanding the great and direct utility of his work, is possibly an indication that better counsels may in time be expected to prevail."

WE understand that the Rev. Osmond Fisher has in the press, and will shortly publish, a new work entitled "Physics of the Earth's Crust." The volume will contain selected and revised portions of papers which have appeared at various times in the *Transactions* of the Cambridge Philosophical Society and other scientific publications, together with new matter. Mr. Fisher will in some chapters apply mathematical methods, but there will be found much matter calculated to interest those readers who do not care for that mode of reasoning.

THE meeting of the British Medical Association for the year 1881 will be held at Ryde, in the Isle of Wight, to which locality the Association has received a cordial invitation from nearly the whole of the medical profession in the island. Mr. Benjamin Barrow, an old and much-respected practitioner in Ryde, has been appointed president-elect. The Council of the Town of Ryde have passed a unanimous resolution that the whole of the Corporation Buildings, which are numerous and spacious, shall be placed at the disposal of the Reception Committee. There is every reason to believe that the many beautiful private grounds in the Isle of Wight will be thrown open to the Association. The president will give a garden party to the members and residents in the island. A *soirée* will be held in the Town Hall and adjoining buildings. The address in medicine will be given by Dr. John Syer Bristowe, London, of St. Thomas's Hospital; the address in surgery will be given by Mr. William Dalla Husband of Bournemouth, Consulting Surgeon to the York County Hospital; and an address in obstetric medicine by Dr. John G. Sinclair Coghill of Ventnor. Such has been the spirit with which the movement has been taken up by the Members of the Association and profession in the Isle of Wight and Ryde that the meeting bids fair to rival any previous meeting both in science and pleasure.—The following grants in aid of scientific investigation for the year were made, viz.:—Dr. McKendrick and Committee, Glasgow, for a continued investigation on anæsthetics, 25*l.*; Dr. Gerald Yeo, London, on the efficacy of the antiseptic method in injuries of the brain, 50*l.*; Dr. Shin, London, for a continued investigation on parasitic skin diseases, 25*l.*; Mr. W. North, London, for a continued investigation on the relations which exist between nitrogenous egesta and muscular work, 50*l.*; Dr. D. J. Hamilton, Edinburgh, an investigation on the pathology of the brain, 30*l.*; Mr. Watson Cheyne, London, an investigation on the relation of organisms of septic disease, 25*l.*; Dr. Augustus Waller, London, an investigation on the time and relations of muscular contractions in the human body in health and disease, 20*l.*; Dr. Alexander Ogston, Aberdeen, a continued investigation on the relation between bacteria and surgical disease, 10*l.*; Dr. Newman, Glasgow, a renewed grant in aid of an investigation on the functions of the kidney, 10*l.*; Drs. Braidwood and Vacher, Birkenhead, to illustrate the third and final report on the life history of contagium, 20*l.*

IN the Vienna Gewerbeverein, Herr F. Siemens has been lecturing on his "regenerative gas-burner," in which the departing heat of the flame serves for pre-heating the air and the gas to be consumed. The products of combustion of the flame, collected in a short chimney, flow away cold, either into the room or to the open air. The light, according to measurements, has twice to three times the illuminating power of the best-known gas-burners, and is remarkably white and steady.

THE death is announced of Dr. Lauder Lindsay, F.R.S.E. F.L.S., at Edinburgh, on November 24, at the age of fifty. Dr. Lindsay's name must be known to our readers as an occasional contributor to our columns. Dr. Lindsay did some good work in botany and geology, and took special interest in the subject of intelligence in the lower animals. In 1870 he published a "History of British Lichens," and quite recently we reviewed his work on "Mind in the Lower Animals," published last year.

ON Monday a deputation, consisting of Mr. Ernest Hart, Prof. Chandler Roberts, F.R.S., Col. Festing, the Rev. H. V. Le Bas, the Rev. S. A. Barnett, Mr. S. Hadley, Mr. W. R. E. Coles, and others, had an interview with the Lord Mayor at the Mansion House, to interest him in the efforts now being made by the joint committees of the National Health and Kyrle Societies to reduce the mischief arising from the present excessive production of smoke in the metropolis. Mr. Ernest Hart said the Societies thought that a very great deal might be practically done to make the atmosphere in London as pure as that in Paris. It was proposed to conduct trials of the various kinds of fuel and to promote competitive testing of the appliances available at present, or which might become available, for the purpose of lessening the production of smoke. The smoke proceeding from the fires of private houses might be materially lessened by the use of improved apparatus, and that from factories might be abated with little interference with the manufacturing interests if the employers would only co-operate with the Societies towards that end. There was about to be an exhibition at South Kensington of the different kinds of apparatus and fuel, which would be practically tested. They now asked the Lord Mayor to let them bring the matter before the notice and attention of the citizens by means of a meeting at the Mansion House on the subject. The Lord Mayor thought it a matter well deserving the public attention, and he would gladly allow a conference in the Long Parlour of the Mansion House on Friday, January 7.

IN connection with the subject of Incandescent Electric lighting it is of interest to notice in the New York *Times* an account of an experiment in this direction. At a reception given on the evening of November 17 by Prof. Henry Draper to the members of the National Academy of Sciences, a part of his house was

lighted by the Maxim light. The laboratory was lighted by eight Maxim electric lamps, which were screwed into the chandeliers in place of the ordinary gas burners. The large laboratory, it is stated, was as light as the open fields at noonday, and there was no flickering or unsteadiness in the light. In shape the lamps are precisely similar to those used by Edison, but H. S. Maxim, who holds the patent on them, claims to have improved on Edison's plan, by making his lamps more permanent. Like Edison, he uses a carbonised fibre, in the form of a horseshoe, but unlike him, does not inclose this fibre in a vacuum, and considers that his lamp is complete. An atmosphere of gasoline vapour is introduced into the glass globe which holds the carbonised fibre, and in this atmosphere the fibre is gradually heated by the electric current. As soon as the heat reaches a sufficient intensity it begins to decompose the hydrocarbon of which gasoline vapour is composed, and if there are any weak spots in the filament the freed carbon is deposited there and strengthens the fibre. A current of increasing intensity is thus carried through the carbonised fibre, which constantly grows at the expense of the gasoline vapour, and finally becomes of a uniform power of resistance throughout its whole length. The gasoline vapour is then pumped out of the globe and the lamp is ready for use. The Maxim lamps are said to give a larger amount of light than any incandescent lamp hitherto constructed. According to experiments made by Prof. Morton, of the Stevens Institute, it appears that the lamps have produced light at the rate of 600 candles per horse-power of current. Each of the eight lights in Prof. Draper's laboratory had an illuminating power of about fifty candles. The electric current for the lamps was furnished by a Maxim dynamo machine, which was driven by a gas-engine of four-horse power, located in the laboratory. The Maxim machine has an armature something like that of the Gramme machine, while its field magnets resemble those of the Siemens machine.

THE recent importations into this country of cinchona bark from Jamaica and the high prices realised have been the means of causing a considerable amount of attention to be drawn to this new source of supply. From a document recently drawn up by Mr. Morris, Director of Public Gardens and Plantations in Jamaica, it seems that the results of the cinchona sales for the year 1879-80 have been as follows:—Quantity of bark shipped 27,399 lb., gross amount realised £5380 9*s.* 6*d.*, net sum realised £5146 8*s.* 7*d.* Without going into details it will suffice to show the superiority of Jamaica bark over that from Ceylon by saying that for red "root bark" the highest price for Jamaica produce was 4*s.* 8*d.* per pound for "good root" as against 2*s.* 6*d.* for "good root" from Ceylon, thus showing an advantage in favour of Jamaica root bark to the extent of 2*s.* 2*d.* per pound. Thus again for "twig and small ordinary" bark of *C. succirubra* Ceylon produce obtained from 2½*d.* to 1*s.* per pound as against 10½*d.* to 1*s.* 6*d.* per pound for similar bark from Jamaica. From this, together with the fact that an enormous number of plants are now in stock in Jamaica, the future of cinchona cultivation in that island seems to be ensured.

IT is stated in an American contemporary devoted to electrical topics that a call has lately been made on the shareholders of the Edison Electric Light Company to the amount of sixty dollars per share. The object of the call was "to meet the expense of recent experiments."

IMPORTANT trials have been made lately on the Rhine, in order that navigation may be carried on at night by means of the electric light. It is hoped that soon satisfactory results will follow, which will probably develop an entirely new phase in river navigation.

IN the neighbourhood of Agram, at the mountainous places St. Simon and Remete, some shocks (of slight importance) were felt up till December 1. At Dortmund, on November 27, a considerable shock occurred at 5.50 a.m. It lasted several seconds, and the direction was south-south-east, barometer 756, temperature 7° R. A rather smart shock of earthquake, accompanied by a loud subterranean noise, was felt at Schaffhausen on Wednesday night last week. The Rev. Dr. Dixon of Beragh, near Omagh, writes that a slight earthquake shock was distinctly felt there on the afternoon of Sunday, November 28, at about half-past five. The peculiar character of the shock was most marked. It appeared to travel from south-west to north-east.

IN the course of his experiences as a medical missionary among the Mongols the Rev. James Gilmour has gathered some interesting information regarding their inner life, but perhaps the most curious item is that Mongol doctors are not entirely unacquainted with the properties of galvanism. It is said that they are in the habit of prescribing the loadstone ore, reduced to powder, as efficacious when applied to sores, and Mr. Gilmour states that one man hard of hearing had been recommended by a lama to put a piece of loadstone into each ear and chew a piece of iron in his mouth!

THE French Great Western Company instituted last year a competition in the large hall of St. Lazare Station, between the Jablochkoff and Lontin light and the gas company. The conclusions were in favour of the electric light, but the gas company having declared that they would abolish entirely the special price charged on the Great Western Company if they declared in favour of gas, the gas lamps have been restored.

*Les Mondes* gives the following old recipe for testing the age of eggs, which, it thinks, seems to have been forgotten. Dissolve 120 grammes of common salt in a litre of water. An egg put in this solution on the day it is laid will sink to the bottom; one a day old will not reach quite to the bottom of the vessel; an egg three days old will swim in the liquid; while one more than three days old will swim on the surface.

THE *Launceston Examiner* (Tasmania) of October 6 contains some account of a shaft that had been sunk for a well at a brewery at Launceston, near the river. Little water was met with, but some interesting observations were made. The shaft had been sunk to a depth of ninety-eight feet. The strata passed through are of a very interesting character. For a little over thirty feet strong clay was met with, then deep beds of compact sand separated by bands a few inches thick of fine quartz conglomerate. About forty feet from the surface considerable quantities of partially carbonised wood were found, extending thence to the bottom of the shaft. The wood is evidently pine, and appears to be identical with that found in the shaft of the Working Miners Company at Brandy Creek, at a similar depth below the river. The grain of the wood is perfectly distinguishable, but the transverse fracture is black and lustrous like jet. The trees must have been of a large size and very abundant, and the great mass of earth that has accumulated above their remains enables one to form some idea of the vast period that has elapsed since they flourished. The great depth of the stratum in which this fossil wood occurs proves that its deposition must have proceeded without material interruption through vast periods of time. It is a little curious that though vegetable remains occur so profusely in the freshwater deposits of the Windmill Hill, and at considerable depths both here and at Beaconsfield, no trace has yet been found of contemporaneous animal life.

THE *Cape Argus* for November 6 contains a full report of a paper read at the Cape Philosophical Society by Mr. J. G. Gambie, containing many useful suggestions as to important problems, especially in meteorology and geology, that await solution in South Africa. Residents and travellers in South Africa would no doubt find the paper suggestive.

## PHYSICAL NOTES

MR. J. E. H. GORDON has lately patented a method of producing light from electricity based upon Mr. Spottiswoode's suggestion to apply the alternating-current magnetoelectric machine of De Méritens to the induction-coil. Mr. Gordon arranges small balls of platinum or iridium, or of an alloy of these metals, at the ends of fine platinum rods in pairs in the middle of a suitable globe, and causes to pass between them a rapid succession of sparks whereby they are raised to incandescence. There is no consumption of carbon or any other substance, and the lamps may be connected either in series or in parallel branched arcs. The principal remaining disadvantage is the noise attendant on the rapid sparks. A mechanical contrivance is added to bring the knobs near together when no current is passing in the primary coil. The induction-coils used are of comparatively small size.

M. TERQUEM (*Jour. de Phys.*, October) prepares, for the receivers of air-pumps, brass plates with a circular groove, in which is put a mastic fusing about 60°. The plate is placed over a vessel of heated water, and when the mastic is fused the receiver is brought down into the groove. When cool, the plate adheres to the jar. These receivers are tubulated, and a caoutchouc stopper in the tubule holds a tube bent at a right angle and provided with a stopcock like those used by M. Carré in his air-pump. For experiments with the air-pump several receivers with their plates can be easily prepared beforehand.

M. LIPPMANN points out (*Jour. de Phys.*, October) that full justice has hardly been done to Carnot with reference to his law (in thermodynamics). It seems to have been forgotten that he verified the law directly by experiment; and did not merely (as is found stated in excellent treatises) furnish a demonstration *à priori* based on the indestructibility of heat. This is doubtless due to the fact that Carnot's original work has long been exhausted and unobtainable. M. Lippmann considers that work a mine imperfectly explored.

EXPERIMENTS have been made by M. Hesehus of the St Petersburg Physical Society, as to the variations of volume and coefficient of elasticity of palladium and its alloys under the influence of hydrogen absorbed. The alloys contained 25 per cent. of gold, silver, and platinum. Wires 500 mm. long and 0·4 mm. diameter served successively as cathode in electrolysis of dilute sulphuric acid in a long vertical glass tube, where they were stretched by weights so that their length could be measured directly with a cathetometer. The alloy containing silver showed the greatest increase of length, 11·7 mm.; palladium-platinum 6·14 mm.; pure palladium 5 mm.; and palladium-gold only 0·9 mm. With a current of six bichromate elements, the elongation, very rapid at first, reached its maximum after nearly an hour. The shortening after breaking the current proceeded in a similar way, but less rapidly; *e.g.* for palladium wire it was only 2·6 mm. after twenty-four hours. Some experiments were made with the aid of a recording apparatus, and they also proved that, contrarily to Graham's opinion, the absorption of hydrogen takes place more quickly than the reverse action, and even when electrolytic oxygen is made to act on the wire (used as anode). M. Hesehus made a special delicate apparatus for measuring small variations in the length of wires. With this it was proved, that during the first day the shortening of the wire charged with hydrogen decreases very quickly, about the third day it becomes constant; it again decreases rapidly about the seventh day, then approaches zero asymptotically. This agrees with MM. Troost and Hautefeuille's experiments on the tension of hydrogen of palladium.

A PLUVIOMETER which registers the quantity of rain, and the duration and hour of the fall, is described by S. Grimaldi in *Rivista Scientifico-Industriale* for October 15.

IN a recent note to the Vienna Academy, on the relation of the daily and yearly variation of temperature to the eleven-years sun-spot period, Herr Liznar first compares observations of the daily variation at thirteen places (including St. Petersburg, Calcutta, and Hobarton), and finds for all some correspondence with the sun-spot curve. The curve from data for Vienna, Prague, Caslan, Brünn, and Trieste from 1857–70, brought to an average, shows, for the minima of this variation in 1859–60 and in 1870–71, a very good agreement with the corresponding maxima of the sun-spot curve; while the maximum of the variation precedes the minimum of the spots by about two years. With regard to the yearly variation of temperature, Dr. Hahn's results for Leipzig are fully confirmed by data from eight other places in Europe, the variation showing a maximum and minimum corresponding to the maximum and minimum of spots.

THE combinations formed by phosphuretted hydrogen with hydrobromic and hydriodic acids have been long known. Its combination with hydrochloric acid has lately been effected by M. Ogier (*Jour. de Phys.*, November) by compressing equal volumes of the gases in M. Cailletet's apparatus. Compressing about 20 atm. at + 14°, small yellowish bright crystals appear, and with sufficient pressure the two gases disappear entirely (if the mixture have been well made), the tube being covered with a crystalline coat without trace of liquid. If the upper part of the tube be heated with tepid water (+ 20°), the compression produces a liquid layer. If the tube be slowly cooled, and 60 or 70 atm. maintained, so as to get only a small layer of liquid, the combination forms slowly in crystalline state. Sudden compression, without external heating, will also produce the liquid. On the other hand, if before there is any deposit of crystals the pressure be relaxed (from 25 atm. *e.g.*) one perceives not a mist, but small, light, solid flocks, which slowly go down the sides of the tube and disappear. The combination can also be produced under cold without pressure; crystals are formed about − 30°. If the compound exist in the gaseous state, it is almost wholly dissociated at ordinary temperature and pressure.

AN amplifying barometer has been invented by M. Debrun (*Jour. de Phys.*, November). Suppose a Fortin barometer, in the tube of which the mercury is kept at a constant height. The cistern has two other vertical tubes open to the atmosphere, one rising out of the mercury, the other from water over the mercury. The variations of the water in the latter are read with the aid of a scale, and they are thirteen and a half times greater than those of the mercury in the other open tube.

RECENT experiments in capillarity by Herr Volkmann (*Ann. der Phys.*, No. 10) have led him to the following results:—1. The influence (affirmed by Wilhelmj) of curvature of the wall on constants of capillarity cannot be maintained, and is explicable by the supposition of a faulty determination of specific gravity. (The arrangement of the index is also objectionable.) 2. Observation of the height of rise between parallel plates warrants the assumption of a constant wall-layer, on which the liquid rises. 3. The thickness of the wall-layer in the case of neat's-foot oil and alcohol is found constant for plates and tubes at 0·004 mm. 4. In so far as the results with neat's-foot oil and alcohol may be extended to other wetting liquids, no influence of curvature of the wall on constants of capillarity is demonstrable.

PROF. SILOW of Moscow has studied the magnetism of iron chloride solution by the method of induced currents (*Ann. der Phys.* No. 10), and finds that the coefficient of magnetisation is not a constant, but a function of the force of separation. As the latter gradually increases, the former at first increases too, and pretty quickly, but reaches a maximum and then decreases, first quickly, then slowly. The liquid is therefore relegated to the same class of magnetic bodies as iron, steel, or nickel, and the author considers that probably all magnetic bodies show this rising and sinking of the coefficient.

IN a paper which appears in the *Ann. der Phys.* (No. 10), Herr Hankel gives the chief results of his study of the photo- and thermo-electric properties of fluor-spar. He states, *inter alia*, that the middles of the cube-faces become, in light, negative, the tension decreasing towards the edges, and especially the angles, which often show the opposite polarity. It is the chemical rays that act. The carbon electric light does better than sunlight. Sparks between two Leyden jars give the effects, but the light of Geissler tubes does not. Green Weardale crystals were the most excitable (of the specimens tried). The intensity of the effect generally grows with the depth of the colouring. The tensions produced by light do not change to those of opposite sign when the crystal is put and kept in the dark. Crystals long exposed to light are weakened in excitability. A moderate heating (to 130° to 150° C.) exalts the photoelectric effect. As to thermoelectricity, rise of temperature produces tensions of the same sign as illumination does. In cooling, the opposite electricities appear. In many crystals weakly excitable by light, the thermoelectric tensions are greater than the photoelectric (especially in the case of brown-red or brown-violet crystals).

## GEOGRAPHICAL NOTES

SOME time back it was publicly stated that Commander Cheyne and his friends intended to apply to the Geographical Society for countenance and support to their plans of Arctic exploration. A deputation accordingly waited on Lord Aberdare, the president, on October 12, and, in pursuance of a suggestion he then made, a statement of Commander Cheyne's plans was lately drawn up by a committee for submission to the Council of the Society. This has been considered, and in reply the President and Council regret that the scheme, as explained by the statement, does not commend itself to them as one containing the elements of success and of usefulness, and that, even if it were feasible, the means proposed to be adopted for encountering the great dangers and difficulties necessarily attendant upon such an enterprise, do not appear to them sufficient. We believe the Geographical Society is to take up the subject of Arctic exploration this session. An Arctic Committee will be appointed to bring together all that has been done since the last English expedition, to enable the Society to decide what steps they should take.

THE post of honour in this month's issue of the Geographical Society's *Proceedings* is naturally assigned to Mr. J. Thomson's report of the journey of the East African Expedition, of which we have already given a *résumé*. It is illustrated by a map showing his route, constructed from the explorer's original map and other sources. There is also a useful little map of a route from Kagéi to Tabora, by the Rev. C. T. Wilson of the Church Missionary Society's Nyanza Mission. Capt. A. H. Markham's "Visit to the Galapagos Islands in 1880" follows, with some observations by Mr. Osbert Salvin on recent additions to our knowledge of the fauna of the group. From the geographical notes we learn that medals and other rewards are to be presented to Mr. Thomson's native followers, and that Dr. Kirk is to receive the formal thanks of the Society for the important services he rendered to the East African Expedition. Some interesting extracts from Capt. Carter's diary on his fatal march from Karema are next given, with a summary of recent news respecting African exploration. The remaining notes deal with M. Mushketof's ascent of the Zarafshan glacier, Russian explorations in Eastern and Western Siberia, surveys in Turkey, and an attempt to explore the affluents of the Rio Purûs.

MR. J. BANTING ROGERS has devised and published a game which is likely to be of service not only as a really interesting amusement, but also as a means of acquiring a considerable knowledge of navigation and meteorology. It is entitled the game of a "Voyage Round the World," and is played on a large board representing the ocean, suitably divided for counting by knots, and with hazards in the shape of cyclones, collisions, &c., which add excitement to the game. The game is played by means of a number of small models of ships of various kinds, and cards in which the number of knots is marked within which the players may move. Logs are kept, watches appointed, and a captain of the watch to record distances, &c. Altogether it will be seen that in Mr. Rogers's ingeniously devised game there are great possibilities both of amusement and instruction.

Two Danish Expeditions which have been carrying on scientific exploration in Greenland have returned to Copenhagen. One of them, under Lieut. Hammer, has been continuing the investigations into the movement of the mainland ice into the fjörds and the formation of icebergs. In the course of the summer several previously unknown fjörds were visited, and the western part of the island of Disko surveyed and mapped. The other expedition, under Lieut. Holm, was to explore several of the large ruins of former settlements in the district of Julianhaab and to obtain information on the population and condition of the east coast. Several extensive ruins were found, which must have been left quite 100 years ago, and of which the present natives know nothing. Among these ruins many objects of ethnological interest were found. The weather during the whole summer was rainy and cloudy; indeed people who have been many years in Greenland never knew of so rainy a summer.

WE believe there is some prospect of Mr. Joseph Thomson being engaged to lead an expedition from Sierra Leone towards Timbuctoo, mainly to establish trading relations between the English Colonies and the interior. It would be a pity should Mr. Thomson be compelled to become a mere trading-caravan leader.

MAJOR SERPA PINTO'S account of his remarkable journey, which is still unpublished, is to be called "How I crossed Africa," instead of "The King's Rifle."

THE following telegram has been received in St. Petersburg from Col. Prejevalsky:—"Have finished my travel. Rich collections: 2000 birds, many mammals, 1300 species of plants. Will be in St. Petersburg at the beginning of January."

AT the last meeting (November 17) of the Russian Geographical Society, Dr. Piasetzky read an interesting paper on China. He has very closely studied the character of the Chinese, their life, their moral principles, and the education of children. Dr. Piasetzky, who has travelled during several years in China, is the author of a very interesting Russian work in two volumes on that country: the work is illustrated with very good drawings, which represent "types" of Chinese towns, streets, dwellings, market-places, &c. At the same meeting the Society resolved to take part in the next Geographical Congress and Exhibition at Venice.

BEFORE proceeding to Paris, as we mentioned last week, MM. Verminck, Zweifel, and Moustier were present at an enthusiastic meeting of the Marseilles Geographical Society, when the President, M. Rabaud, after a eulogistic address, presented them with medals for the part they respectively took in the expedition to the sources of the Niger.

LIEUT. E. W. PETLEY, of the Marine Survey of India, has lately drawn up some interesting notes on Marmagao (Goa), Portuguese India.

THE new *Bulletin* of the Antwerp Geographical Society contains an account of Mr. Andrew Goldie's last journey in New Guinea, and some observations on artesian wells in the Sandwich Islands.

MR. TODD, the Government Astronomer at Adelaide, is to proceed next May to Port Darwin, in the Northern Territory, to determine by telegraph the difference of longitude between that place and Greenwich.

A RECENT telegram from the Austrian traveller Oscar Lenz states that he had reached Medina, Senegal, on November 2. Oscar Lenz penetrated to Timbuctoo from the north, and went thence by Bassikonon, Sokolo, Goumbou, Nioro, and Konniakany to Medina.

HERR STIER, director of the Gymnasium in Zerbst, found, a short time ago, a detailed account of Vasco da Gama's second voyage to India. It is drawn up by a Dutchman (who accompanied Vasco da Gama), and in his own tongue. Herr Stier has now published a German translation of it.

## MR. MUNDELLA ON EDUCATION IN SCIENCE

ON Friday last the Textile and Dyeing Departments of the Yorkshire College, Leeds, were formally opened, and at the dinner which followed the Right Hon. A. J. Mundella, M.P., Vice-President of the Council, proposed the toast of the occasion:—"Success to Yorkshire College." His remarks in connection therewith are so significant, coming from our *de facto* Minister of Education, that we give them in full.

There had not, he commenced by saying, been a more gratified spectator of the proceedings of that day than he was. There had been no one amongst them who had enjoyed more, if so much, the sense of satisfaction—he had almost said of triumph—that he had enjoyed that day. Sixteen years ago when he was, like many of those present, a captain in the ranks of industry, he took some interest in the question of the application of science to the industries of this country. His attention had been called to it by the advantages he possessed of seeing what was being done in other countries. He saw the infancy of technical education abroad, and now he stood by its cradle at home. The School of Arts et Métiers in Paris was not by any means a new school, and it had done great things for French industry. There was no one who was acquainted with that school who would not endorse his remarks when he said that it had done marvellous things for French manufactures, and he had learned since he came to Leeds that we had some of its most distinguished scholars in this town. He witnessed the beginning of technical instruction in Germany with the erection of the Polytechnic School of Zurich; and when he went to the members of the Chamber of Commerce of which he was

president, and told them what he had seen, the answer was that they had great doubts about the success of the experiment. It was thought then that the practical place to give technical instruction and teach the application of science to industry was in the workshops. They had now satisfied themselves, however, that whilst they could not dispense with the practical experience of the workshops, there was something that gave value to that experience. Let them take the art of dyeing for example. What was the old system of training in regard to it? The dyer did not then ascertain the properties of the articles with which he had to deal with that skill and accuracy with which the young men of Leeds were ascertaining them to-day. It used to be a bucketful of this, a shovelful of that, and a handful of the other. But the days of the old rule of thumb were numbered; and on standing at the cradle of the Yorkshire College he stood by the grave of the rule of thumb. He had been greatly encouraged this week by his visit to Yorkshire. He came to it somewhat in a state of despondency: not however with reference to elementary instruction, for the people of Yorkshire were doing wonders in that way, and in a few years hence this county would compare favourably in that respect with any part of the globe. But he had been examining recently, not for the first but the tenth time, what was being done on the Continent in the way of technical education. They had opened a good school in Leeds, but they must not flatter themselves. They must not believe that the 25,000*l*. which his friend Mr. Denison had indicated was the sum wanted to complete the work. He had stood in an industrial town of 70,000 inhabitants, in which a single building that had been erected within the past three years solely for teaching science, as applied to industry, had cost 100,000*l*. He had stood in three or four such towns. He had examined technical institutions in France, in Switzerland, and in the south and north and centre of Germany, and all he could say was, that not having examined these institutions critically for five years, he stood amazed and almost aghast at what he beheld. He came home feeling that in the countries he had mentioned they had found the weak place in our armour, and had wounded us in our tender part; but what he had seen in Yorkshire within the last week had given him renewed confidence and courage. He found, in addition to this splendid institution which had been opened to-day, that in the little town of Keighley—a very splendid little place—they were going to spend 5000*l*. in a weaving-school; that the Clothworkers' Company of London were going to assist Bradford also; and he was told that in Huddersfield they had got 15,000*l*. or 16,000*l*.; that they had no longer to teach elementary instruction in their night-classes, but wanted to give scientific and technical instruction to their workmen, and wanted a school for Huddersfield. Yesterday he stood by the grave of an eminent Yorkshireman who had done noble service to the teaching of science in Yorkshire—his friend Mr. Mark Firth. Would they not see that Yorkshire had many as worthy sons as Mr. Firth? Surely he was not the last man that would endow a college for science teaching. There were men, he hoped, within the sound of his voice who would perpetuate their memory, and show some gratitude to the industry that had made them wealthy by endowing another wing of the College like the one they had seen to-day. They must not believe that this was mere amateur work. This was not science teaching merely for the sake of scientific research, for arriving at scientific truth, or for giving intellectual culture. Those nations on the Continent who had produced such magnificent buildings, machinery, and apparatus to conduct this work were not doing so from sentimental reasons. They were not doing it with the object simply of endowing scientific research, or to make great progress in any particular branch of science. Their object was a very prosaic and a very practical one, and very full of self-interest. What they meant was to get industrial strength, which they believed was the real source of the wealth of their nation. The Yorkshire College was founded to supply instruction in those sciences which were applicable to the industrial arts. He might say as the result of his recent observations that France and Germany were conducting as active a competition with each other in this matter of arming for the industrial fight as any of the nations of the Continent of Europe were in their military armaments with a view to any catastrophe in future. But this was not a case in which Englishmen could look on with benevolent neutrality, because after all in this international fight they could not stand aloof, they could not remain neutral, for the blow, whenever it fell, would fall upon them. Rely upon it the success of the Science College of Yorkshire meant the success of Yorkshire itself. They possessed great natural resources for which their Continental neighbours envied them. They had in their immediate neighbourhood, in the mine, the coal and iron; they had in their people great vigour, great energy, and great inventive capacity; and they had also their old prestige. They had amongst them men of great wealth. There was his friend Mr. Denison ready to provide them capital very freely—at a very moderate rate. England, after all, was the great emporium as a depôt market for nearly all the raw material of the world. To London came that Australian wool so many thousand bales of which were exported to their neighbours on the other side of the water, and then came back to them in a finished state for the consumption of their own population. He was speaking from actual knowledge when he said that there was an enormous increase in the manufacture of dressed goods that could be well made in Yorkshire, that could be produced and sold in Yorkshire, and that were yet made abroad, but ought to be made at home. He believed the step they were taking that day in opening the College was the very way to create that employment at home which at present was too much done abroad. It had been said that the country gentlemen ought to assist in this movement. Lord Frederick Cavendish had come from a great and honourable house, and they all rejoiced in the wealth, ability, business capacity, sagacity, and liberality of that house. But what was it that had made these great houses and England wealthy? Was it not the value which had been added to the land by the success of the great manufactures? The success of the great houses of England was bound up in the success of the Yorkshire College and of other colleges like it. Thus to the success of their manufactures they must look for the continued greatness of England in its dealings with nations in the future. Why, they had but the same area of land now as they had when their population was only 10,000,000. They had 25,000,000 of people in England and Wales now, and they were multiplying at a rate which would soon double this number. What was it that was to feed all these people but the success of their manufactures? If they were to hold their own they must not lose a point; they must not neglect a single opportunity; they must not rest content on their old prestige; but they must, as Englishmen, look the difficulty in the face, and, where weakness existed, strengthen themselves, and this weakness was to be found entirely in the question of education, which they had too long neglected. In asking them to drink success to the Yorkshire College, he was asking them practically to drink to themselves. If they wished perfect freedom to carry on this work, he was quite of the opinion of Lord Frederick Cavendish that they must adopt the newest methods—to be untrammelled in their efforts, to carry on the College by themselves, and in that way in which Englishmen had been accustomed to do their work.

## *THE ROYAL SOCIETY—ADDRESS OF THE PRESIDENT*[1]

### II.

THE aspect of spectrum analysis has become much complicated by two sets of facts. First, the increased dispersion, the improved definition, the enlarged electrical power at our command, and, above all, the substitution of photography for eye observations, have revealed to us an almost overwhelming array of lines belonging to each substance. And, secondly, the same means have shown that many substances present different spectra when in different molecular states. These complications have led spectroscopists to seek some relief in theories of simplification. Lecoq de Boisbaudran, Stoney, Soret, and others have suggested that many of the lines, or groups of lines, may be regarded as the harmonics of a fundamental vibration; and they have shown that in certain cases this view will account for the phenomena observed. Professors Liveing and Dewar have contributed largely to the subject by their observations on the reversed lines. Looking in another direction, Mr. Lockyer considers that in increased temperature we have the means not only of resolving compound bodies into their elements, but even of dissociating bodies hitherto regarded as elementary into still more simple substances. There still remain serious difficulties connected with Mr. Lockyer's views; but it is to be hoped that his indefatigable energy will in some way or other ultimately overcome them.

The outlying parts of the spectrum, beyond the visible range,

[1] Address of William Spottiswoode, D.C.L., LL.D., the President, delivered at the Anniversary Meeting of the Royal Society on Tuesday, November 30, 1880. Continued from p. 114.

must always be a subject of interest; and while MM. Cornu and Mascart, and others, have extended our knowledge of the ultra-violet end, Major Abney has opened out to us a new region beyond the red. Lord Rayleigh and others before him have however proved that there must be a limit at the least refrangible end of the spectrum. Prof. Stokes, long since, noticed the difference in length between the spectrum of the sun and that of the electric arc; and M. Cornu has recently shown by observations at elevated stations that the great rapidity of atmospheric absortion must preclude the hope of any great extension of the solar spectrum toward the more refrangible end.

The striking advances made in electricity during the last few years, and marked by, amongst other things, the inventions of the telephone and the microphone, have been followed by a step not less daring in its conception, nor less successful in its execution; I allude, of course, to the photophone, the result of the researches of Mr. Graham Bell and Mr. Sumner Tainter. The principle of this instrument is already known. A powerful beam of light is first thrown upon a flexible mirror, the curvature of which is modified through vibrations set up in it by the human voice. The reflected beam is then received by a selenium "cell" forming part of an electric circuit. The intensity of the light so received, and with it the resistance in the circuit due to the selenium, varies with the varying curvature of the flexible mirror. A large parabolic mirror is used at the distant station to concentrate the light on the selenium "cell"; and a telephone in the circuit reproduces the variations in the form of sound.

Mr. Bell has however also shown that rays from the sun, or an electric lamp, when rendered intermittent by any convenient means, will set up in a plate of almost any substance vibrations corresponding to the intermittence. The substances as yet tried are: metals of various kinds, wood, india-rubber, ebonite, &c., and among them zinc appears to be one of the best suited for the purpose. This result, which is independent of any electric action, is perhaps due to heat rather than to light.

In these, as in many other issues of scientific research, we can hardly fail to be impressed by the almost inexhaustible resources which lie ready to hand, if we only knew how to use them, for the interpretation of nature or for the practical purposes of mankind.

During the past year Prof. Hughes employed his induction balance for the detection of very minute impurities in small masses of gold. Mr. Preece also has shown how slight increments of temperature in fine wires transmitting telephonic currents of electricity will suffice to reproduce sonorous vibrations, and even articulate speech, at a distant station by their influence on thin platinum wires only six inches in length.

Mr. Stroh has shown that, at the point of contact of two metals carrying strong electric currents, adhesion takes place, varying with the nature of the surfaces in contact; and that many of the effects at points of contact, previously attributed to induction, may be due to the peculiar action now for the first time brought under notice.

It is worthy of record that two Atlantic cables have been successfully laid during the present year; but that the operation has become so much a matter of course, that its occurrence has attracted little public attention. Two cables, each of more than 500 miles in length, have been laid across the Mediterranean; and the Cape Colony has been placed in telegraphic communication with this country by a cable of not less than 4400 miles.

Constant attention is paid in the General Post Office to the introduction of improved methods for the furtherance of the telegraphic communication throughout the country.

Steady progress has been made in bringing the electric light into practical use. The illumination of the Albert Dock of the London and St. Katherine's Dock Company, the Liverpool Street Station of the Great Eastern Railway, the St. Enoch's Station of the Glasgow and South-Western Railway, and last, but not least, that of the reading-room of the British Museum, have become accomplished facts; while the City authorities have decided to extend the use of this light over various thoroughfares under their control. The subdivision of the light for domestic purposes is a problem which appears to have found a solution in the incandescent carbon lamp of Mr. Swan. Besides this, Mr. J. H. Gordon has devised, for the same purpose, a very ingenious application of rapid sparks from alternating machines, such as that of De Méritens, to produce incandescence in refractory metals. Lamps constructed on this principle completely fulfil the conditions of subdivision, but some difficulties of detail still retard their adoption for general use. There is, however, every reason to hope that the experience already gained, and the intelligence at present brought to bear upon it, will before long supply us with more than one form of domestic light.

The chief question of interest which has occupied the attention of the Iron and Steel Institute has been the adaptation of the "basic" process to the production of steel from pig metal containing a considerable percentage of phosphorus. Hitherto only pure hæmatite and spathic ironstones have been used for the production of steel; but it has now been shown that, by the employment of basic linings and basic slags, the metal is almost completely cleared of its phosphorus, and that steel of good quality may be produced from inferior ore.

The Conference on Lightning-Conductors, composed of delegates from the Royal Institute of British Architects, the Society of Telegraph Engineers, the Physical Society, and the Meteorological Council, is steadily pursuing its labours. A large mass of facts has been accumulated; several leading questions have been decided; and it is hoped that, in the course of the coming year, the Report of the Conference will be issued.

One of the most interesting, and at the same time useful, applications of the dynamo-machines, is that of transmitting mechanical power to spots, or under circumstances, where the ordinary appliances cannot be conveniently used. Their principle will doubtless by degrees extend itself over a wide range of industry; especially in localities where water-power is abundant. A very remarkable instance of such adaptations will be found in Dr. Werner Siemens's propulsion of railway carriages in Berlin.

Our Fellow, Dr. C. W. Siemens in London, and M. De Méritens in Paris, have demonstrated the use of the high temperature of the electric arc in fusing refractory metals. The method of operation, while peculiarly convenient for laboratory purposes, and for demonstration, promises to be capable of extension, even to the large demands of commerce and manufacture.

I should not, moreover, omit mention of the very beautiful experiments by Dr. C. W. Siemens on the effect of the electric light on the growth of plants, on the opening of flowers, and on the ripening of fruit. On this subject we hope to hear more hereafter. He has already commenced a fresh series of experiments, and contemplates continuing them during the coming winter.

I am not sure how far the fact is known to the Fellows of the Royal Society that the Society of Telegraph Engineers has thrown open to the scientific world a remarkable collection of books on electrical science, collected by our late Fellow, Sir Francis Ronalds, and bequeathed by him to that Society. The catalogue, compiled by the collector, is a monument of concentrated and well-directed labour.

As regards the Transit of Venus in 1874, the printing of the observations is complete for the two groups of stations in the Sandwich Islands and Egypt, and that for others is in progress.

Preparations are already being made with a view to the observation of the Transit of Venus in 1882. As a preliminary step for this operation, as well as for general purposes, it had been decided that the longitude of the Cape Observatory should be definitively determined by telegraphic connection with Aden, which place is already telegraphically referred to Greenwich; and, notwithstanding a temporary interruption on the land line, Capetown-Durban, it may be hoped that the connection will be effected at no distant period. Mr. Gill is prepared to undertake the main share of the work. With the same objects in view, on the urgent representation of the Astronomer-Royal, it has also been determined to connect one of the Australian Observatories with Greenwich, through Madras, the longitude of which is well known; and this operation will be very much facilitated by the share which Mr. Todd, Government Astronomer and Superintendent of Telegraphs at Adelaide, would be prepared to take in it under the auspices of his Government. The eastern boundary of the Colony having been defined by Imperial Act as the 141st meridian, a wish has been expressed officially for the accurate connection of Adelaide with Greenwich, independently of the Transit of Venus.

The Astronomer-Royal has explained in detail the preparations which he considers necessary, so far at least as this country is concerned, for the effective observation of the transit, and he has introduced several alterations in the plan which he had formerly

suggested. The experience of the transit of 1874 points to the desirability of sacrificing something in the magnitude of the parallax-factor for the sake of securing a higher elevation of the sun; thus, for retarded ingress, Sir George Airy had at first proposed to refer principally to the coasts of the Canadian Dominion and the United States of North America, where the sun's elevation is from 15° to 18°; he now proposes to substitute for this the whole chain of West India Islands, from the eastern extremity of Cuba to Barbadoes, or stations on the neighbouring continent of Central America. Bermuda is also included as a favourable point for observation. Most, if not all, of the longitudes required have been determined with great precision by the Hydrographic Department of the United States. For ingress accelerated, Sir George Airy relies entirely upon stations in the Cape Colony. For the accelerated egress, all the stations suggested for ingress retarded will be available. For egress retarded, although the fixed Observatories at Melbourne and Sydney will contribute to the observation of the phenomenon, they will have the sun at a somewhat low elevation (10—14°); it is thereby proposed to rely mainly upon New Zealand, with which we are in telegraphic communication *viâ* Sydney. Considerable correspondence has taken place on the subject of Australian longitude, and it is expected that the necessary steps to effect the connection of one of the Observatories, probably Adelaide, with Madras, will be taken early in the ensuing year.

Sir G. B. Airy has completed the laborious calculations in his Numerical Lunar Theory, from which the corrections to the coefficients of Delaunay's Lunar Theory are to be deduced; and in connection with this work he has made an investigation of the value of the Moon's Secular Acceleration, for which he finally obtained the value 5″·477, thus confirming the results obtained by Prof. Adams, and subsequently by Mr. Delaunay. On this important question, Prof. Adams has also published an investigation (*Monthly Notices*, vol. xl. Nos. 6, 7, 8 and 9).

A new determination of the Physical Libration of the Moon from a large number of lunar photographs taken with the De La Rue reflector at the Oxford University Observatory has been recently made by Prof. Pritchard, the result being to indicate the existence of a small rotational inequality.

Messrs. J. Campbell and Neison have made use of the Greenwich Observations, 1862 to 1876, to determine the Lunar Parallactic Inequality, from which they deduce for the value of the Solar Parallax, 8″·778, or 8″·848, according as the existence of a forty-five year inequality, apparently indicated by the observations, is admitted or not (*Monthly Notices*, vol. xl. Nos. 7 and 8). The Sun's Parallax has also been determined by Mr. Downing, from N.P.D. observations of Mars at Leyden and Melbourne, in 1877. The value thus found is 8″·96 (*Astronomische Nachrichten*, No. 2288).

In continuation of his researches on tidal retardation from the action of a satellite on a viscous planet, Mr. G. H. Darwin has investigated the secular changes in the orbit of a satellite, deducing the early history of the earth and moon from the time when they were initially in contact, each revolving in the same period of from two to four hours. This leads to the suggestion that the moon was produced by the rupture of the primæval planet. In another memoir, Mr. G. H. Darwin gives analytical expressions for the history of a planet and a single satellite. (*Phil. Trans.*, 1879, *Proc.* Roy. Soc., Nos. 200 and 202.)

An important work in connexion with the United States Northern Boundary Commission has been published by Mr. Lewis Boss, on the Declination of Fixed Stars. The systematic corrections to some seventy catalogues have been discussed, and, from the mean of the whole, standard declinations of 500 stars have been deduced.

Dr. Gould's "Uranometria Argentina" and M. Houzeau's "Uranométrie Générale," are of especial value as giving important information on the brightness and distribution of the stars in the southern hemisphere.

Interesting results as to the diameters of satellites have been obtained by Prof. Pickering from photometric observations, on the assumption that their albedos do not differ greatly from those of their respective primaries. (*Annals*, Harvard College Observatory, vol. xi.) He has further investigated, on somewhat similar principles, the dimensions of the fixed stars, with especial reference to binaries and variables of the Algol type. (*Proc.* Amer. Acad., vol. xvi.) Prof. Pickering has also commenced a photometric survey of the heavens, in which the brightness of every star visible to the naked eye is to be determined. He has further undertaken a search for planetary nebulæ by a new method, in which, by the use of a direct-vision prism in front of the eyepiece, the nebula is at once detected by its monochromatic spectrum, focussing a point of light instead of a coloured line as in the case of a star. About a hundred thousand stars have been examined, and four new planetary nebulæ have been detected. (*American Journal of Science*, October, 1880.)

From the grouping of the aphelia of certain periodic comets Prof. G. Forbes has inferred the existence of two ultra-Neptunian planets, and has indicated their approximate positions. (*Trans.* Roy. Soc., Edinburgh.) Mr. D. P. Todd has deduced from the perturbation of Uranus a position for an ultra-Neptunian planet closely agreeing with that found by Prof. G. Forbes. So far, the search for the hypothetical planet with the 26-inch Washington refractor has been unsuccessful. (*American Journal of Science*, September, 1880.)

Prof. Bredichin's researches on the tails of comets have led him to the classification of these appendages according to the value of the solar repulsive force which would have generated them. Having discussed the forms of the tails of thirty-three comets, he finds that they belong to three types, corresponding respectively to repulsive forces 11, 1·4 and 0·3 (the sun's gravitation being taken as 1); and adopting Zöllner's hypothesis of a repulsive force, due to electricity and inversely proportional to the specific gravity, he infers that the tails of the three types are composed respectively of hydrogen, carbon, and iron. In the case of the second and third types other elements of nearly the same atomic weight may replace or be mixed with the carbon and iron, and in such a comet as Donati's a number of substances may be mixed in the tail, which will consequently spread out in the plane of the orbit. The first type composed of hydrogen will always remain separated from the others. (*Annales* de l'Observatoire de Moscou, vols. iii-vi.)

The appearance, at the beginning of this year, of a great comet in the southern hemisphere, recalling by the length of its tail and the smallness of its head the remarkable comet of 1843, has excited great interest, more especially as it was found that the orbits of the two comets were sensibly the same. The observations of the comet of 1843, however, do not appear to be compatible with so short a period as thirty-seven years, and Prof. Oppolzer has shown that the action of a resisting medium would not meet the case. (*Astronomische Nachrichten*, Nos. 2314, 2315.) Under these circumstances Prof. D. Kirkwood has suggested that the two bodies may be fragments of one original comet, viz., that of 370 B.C., which is said to have separated into two parts like Biela's comet (*Observatory*, No. 43.) Five other comets (including Faye's periodical comet) have been discovered this year, but two of them were lost through cloudy weather before a second observation could be obtained.

In astronomical physics Mr. Huggins has obtained photographs of stellar spectra, which establish the existence of a remarkable group of nine bands in the ultra-violet, probably due to hydrogen, and further lead him to an arrangement of the stars in a continuous series according to the breadth and marginal difference of the typical lines, particularly of the K line. Mr. Lockyer continues his researches on dissociation, as indicated in solar outbursts, and in connection with this work is engaged on a systematic observation of the spectra of sun-spots. At the request of the Committee on Solar Physics, corresponding observations are being made at Greenwich.

From the series of Greenwich photographs of the sun, 1874—1879, the mean heliographic latitude of spots and mean distance from the sun's equator, have been deduced for each rotation and for each year ("Greenwich Spectroscopic and Photographic Results," 1879).

A fine 36-inch silver-on-glass reflector has been recently constructed by Mr. Common, and with this instrument he has obtained photographs of Jupiter, showing the red spot, and of the satellites (*Observatory*, No. 34).

At the outset of an undertaking one figures to oneself in imagination what may be done; towards the close of it one sees in actual fact what has been done. In commencing this address I had hoped to say something of the progress of mathematics; before bringing it to a conclusion I find my space filled and my time exhausted. How far the good intentions of this year may be realised in the next, cannot yet be seen; but the difficulties of a task do not always diminish the fascination of making an attempt.

## THE ROYAL SOCIETY MEDALS

AT the conclusion of his anniversary address on Tuesday last week, the President, Mr. Spottiswoode, delivered the medals which have been awarded this year, and in doing so spoke as follows:—

The Copley Medal has been awarded to Prof. James Joseph Sylvester, F.R.S. His extensive and profound researches in pure mathematics, especially his contributions to the Theory of Invariants and Covariants, to the Theory of Numbers, and to Modern Geometry, may be regarded as fully establishing Mr. Sylvester's claim to the award of the Copley Medal.

One Royal Medal has been awarded to Prof. Joseph Lister, F.R.S. Mr. Lister's claims to the honour of a Royal Medal are based upon his numerous and valuable contributions to physiological and biological science during the last thirty years.

By permission of its author, the Fellow of the Society best qualified, by his own extensive researches on the germ theory, to form a judgment, I quote the following account of Prof. Lister's work and achievements:—

"In 1836 and 1837 it was proved independently by Cagniard de la Tour and Schwann, that vinous fermentation was due to the growth and multiplication of a microscopic plant. At the same time Schwann described experiments which illustrated and explained the conditions, now well known, by which flesh may be preserved from putrefaction. But Schwann's researches were overshadowed by the views of accepted authorities, and they continued so up to the publication of Pasteur's investigations. From this point forward the view gained ground that putrefaction is the work of floating microscopic organisms; and that if air be thoroughly cleansed of its suspended particles, neither its oxygen, nor any other gaseous constituent, is competent to provoke either fermentation or putrefaction.

"Condensed into a single sentence, the merit of Mr. Lister consists in the generalisation, to living matter, of the results obtained by Schwann and Pasteur with dead matter. He began with cases of compound fracture and with abscesses. In simple fracture the wound is internal, the uninjured skin forming a protecting envelope. Here nature works the cure after the proper setting of the injured parts. In compound fracture, on the other hand, the wound extends to the surface, where it comes in contact with the air; and here the operator can never be sure that the most consummate skill will not be neutralised by subsequent putrefaction.

"In the earliest of his published communications Mr. Lister clearly enunciates, and illustrates by cases of a very impressive character, the scientific principles upon which the antiseptic system rests. He refers to the researches of Pasteur, and shows their bearing upon surgery. He points to the representative fact, then known but unexplained, that when a lung is wounded by a fractured rib, though the blood is copiously mixed with air, no inflammatory disturbance supervenes; while an external wound penetrating the chest, if it remains open, infallibly causes dangerous suppurative pleurisy. In the latter case the blood and serum are decomposed by the microscopic progeny of the germs which enter with the air; in the former case the air is filtered in the bronchial tubes, and all solid particles are arrested. Three years subsequently this inference of Prof. Lister was shown to be capable of experimental demonstration.

"After enunciating the theoretic views which guided him, he thus expresses himself in his first paper:—

"'Applying these principles to the treatment of compound fracture; bearing in mind that it is from the vitality of the atmospheric particles that all the mischief arises, it appears that all that is requisite is to dress the wound with some material capable of killing these septic germs, provided that any substance can be found reliable for this purpose, yet not too potent as a caustic.'

"This is the thesis to the illustration and defence of which Prof. Lister has devoted himself for the last thirteen years. His thoughts and practice during this time have been in a state of growth. His insight has been progressive; and the improvement of experimental methods founded on that insight incessant. By contributions of a purely scientific character, which stamp their author as an accomplished experimenter, he has materially augmented our knowledge of the most minute forms of life. The titles of his papers indicate the direction of his labours from time to time; but they give no notion of the difficulties which he has encountered, and successfully overcome. He performs, without dread of evil consequences, the most dangerous operations. He ventures fearlessly upon treatment which, prior to the introduction of his system, would have been regarded as no less than criminal. In the Glasgow Royal Infirmary, when wards adjacent to his had to be abandoned, he operated with success in an atmosphere of deadly infectiveness. Vividly realising the character and habits of the 'invisible enemy' with which he has to cope, his precautions are minute and severe. This demand for exactitude of manipulation has rendered the acceptance of the Antiseptic System slower than it would otherwise have been; but a clear theoretic conception has this value among others: it renders pleasant a minuteness of precaution which would be intolerable were its reasons unknown.

"The operative surgeons of our day have raised their art to the highest pitch of efficiency. Their skill and daring are alike marvellous. Mr. Lister urges an extension of this skill from the operation to the subsequent treatment, contending that every surgeon ought to be so convinced of the greatness of the benefits within his reach as to be induced to devote to the dressing of wounds the same kind of thought and pains which he now devotes to the planning and execution of an operation. His impressive earnestness; his clearness of exposition; his philosophic grasp of the principles on which his practice is founded—above all his demonstrated success—have borne their natural fruit in securing for him the recognition and esteem of the best intellects of the age.

"In a letter addressed to the writer on the 29th of September, 1880, Prof. Helmholtz expresses himself thus:—

"'Prof. Lister ist als einer der hervorragendsten Wohlthäter der Menschheit zu betrachten, und als eines der glänzendsten Beispiele, wie segensreich scheinbar minutiöse und abstruse wissenschaftliche Untersuchungen, wie die über di Erzeugung mikroskopischer Organismen, werden können, wenn sie von einem Manne von umfassendem geistigen Gesichtskreise aufgenommen werden.'"

"In a letter dated October 1st, 1880, Prof. Du Bois Raymond writes:—

"'The period of bloody warfare through which we passed not long ago, just when Prof. Lister's methods were matured enough to be freely used even on the battlefield, has of course contributed to render his name popular throughout Germany; nay, to make it a household word in many homes. We use the word 'listern' as a verb to designate the use of the carbol-spray while bandaging a wound. I do not hesitate to proclaim Lister the greatest benefactor of mankind since Jenner's wonderful discovery—far superior, indeed, to Jackson and Simpson; because, whatever may be the dread of pain and the blessing of being spared it, in Lister's invention health and life itself are concerned, as in hardly any other medical discovery except vaccination. Moreover, the general ideas which have led to Prof. Lister's conception stamp his work with a peculiarly scientific character.'

"In a letter dated from Vevey on the 10th of this month, Prof. Klebs of Prague, himself a distinguished worker in this field, expresses in the strongest terms his admiration of the profound philosophical intuition and practical success of Mr. Lister, as having not only reformed the whole art of surgery, but given a new impulse to medical science generally. Prof. Klebs's interpretation of the opposition encountered for a time by Mr. Lister is worthy of mention. He ascribes it to the high standard attained by British surgery before the time of Lister. 'The operators,' he says, 'that work under the best hygienic conditions will not feel so acutely as others do the necessity of disinfecting wounds. But the good results of the former British surgery are now surpassed by the new method, which is accepted at the present time by the whole world.'

"Such testimonies might be multiplied to any extent. The foregoing are the answers received from the only three gentlemen who have been requested to express an opinion as to the merits of Mr. Lister."

The second Royal Medal has been awarded to Capt. Andrew Noble, late R.A., F.R.S. Capt. Noble is joint author with Prof. Abel of the "Researches on Explosives," *Phil. Trans.*, 1875, which, in combination with other labours in the same field, procured for Prof. Abel the honour of the Royal Medal in 1879. To Prof. Abel is due mainly the chemical part of these investigations; to Capt. Noble the mechanical and mathematical part. Each is a complement of the other, but it

may be safely affirmed that they could not have been presented to the world in the form in which they appear without the co-operation of his remarkable union of technical knowledge and mastery of mathematical analysis with the chemical science of Prof. Abel. His beautiful invention of the Chronoscope, an instrument constructed by him at great cost, by which intervals of time as small as the one-millionth part of a second can be measured, has been of indispensable value in these researches. He is the author of papers which have been translated into most European languages on subjects of gunnery and gunpowder; he is perhaps the highest authority we possess on the higher branches of artillery science, and the best known on the Continent. His great talents and attainments are not more conspicuous than his singular modesty and his indefatigable industry. He has been engaged on these subjects about twenty years, having published the first experiments in this country with Navez' electroballistic apparatus, in 1862.

The Rumford Medal has been awarded to Dr. William Huggins, F.R.S. In 1866 a Royal Medal was awarded to Dr. Huggins for his important researches. Since that time he has been continually engaged in prosecuting the subject of celestial spectroscopy, both in the departments in which he had already done so much, and in others of its branches. One subject of Dr. Huggins' researches relates to the determination of the radial component of the velocity of the heavenly bodies relatively to our earth, by means of the alteration of the refrangibility of certain definite kinds of light which they emit, or which are stopped by their atmospheres. The smallness of the alteration corresponding to a relative velocity comparable with the velocity of the earth in its orbit makes the determination a matter of extreme delicacy. But as early as 1868 he had obtained such trustworthy determinations that he was able to announce before the Royal Society in that year that Sirius was receding from our solar system with a velocity of about 29·94 miles per second.

In a paper presented to the Royal Society in 1872 he has given the results obtained for a large number of stars, and has shown that some are receding and some approaching, and that there seems to be a balance of recession in those parts of the heavens, from which we have reason, from the observed proper motions, which of course can only be transversal, to conclude that the solar system is receding, and a balance in favour of approach in the opposite direction; while yet it does not appear that the motion of the solar system would alone account for the whole of the proper motions of the stars in a radial direction.

The same inquiry was extended to the nebulæ, the spectrum of which consists of bright lines, and in this case it presented greater difficulties. As those nebular lines which appear pretty certainly to be identifiable with hydrogen are too faint to be employed in the investigation, and the others are not at present identified with those of any known element or compound, he was obliged to avail himself of a coincidence between the brightest nebular line and a line of lead. But as the coincidence is probably merely fortuitous, the results give only the *differences* of approach or recess of different nebulæ. The observations seem to show that, so far as has been observed, the nebulæ are objects of greater fixity as regards motion in space, than the stars.

The other subject to which Dr. Huggins has more particularly devoted himself of late, is the mapping of the photographic spectra of stars. This was a research of great delicacy, partly on account of the small quantity of light at the disposal of the observer, partly from the great accuracy with which the comparison had to be made with the spectra of known substances, in order that satisfactory conclusions should be deducible as to the presence or absence of such or such substances in the stars. The results obtained led to a remarkable division of the stars into two great classes, naturally with transition cases, namely, white stars, which showed a group of twelve dark lines belonging, apparently, to the same substance, probably hydrogen, and the group of stars, of which our own sun may be taken as a type.

Besides the researches already mentioned, other papers have been presented by Dr. Huggins to the Royal Society, on the spectra of comets, on the spectrum of Uranus; and in particular one in which he showed that it was possible to detect the heat of the stars, and has given the results obtained for several.

The Davy Medal has been awarded to Prof. Charles Friedel, Member of the Institute of France.

From 1856 to the present time the investigations of M. Charles Friedel, ranging over widely-remote fields of chemical inquiry, have been continuous, numerous, and important. Mineralogical, theoretical, and general chemistry are indebted to him for many valuable contributions; but it is in the department of so-called organic chemistry that he has more especially laboured; and herein he has done much to assist in breaking down the barriers at one time regarded as impassably isolating the chemistry of carbon compounds.

Among the subjects of M. Friedel's successful work may be mentioned more particularly the chemistry of the 3-carbon family of organic bodies, to which belong propionic acid, lactic acid, glycerine, propylene, and acetone. The establishment of the constitution of lactic acid and of acetone, with the determination of the relationships to one another of the various, and in many cases isomeric, members of this large family, constituted for a long time one of the most fiercely-contested, as it was, and is, one of the most fundamental problems of organic chemistry. In the labours effecting the satisfactory solution of this problem M. Friedel bore a large share.

Passing to another branch of investigation, M. Friedel, partly by himself, but largely in conjunction in some parts of the work with Mr. J. M. Crafts, and in other parts with M. A. Ladenburg, made out, or confirmed in a very striking manner, the analogy subsisting between the modes of combination of carbon and of silicon, the most characteristic elements of the organic and inorganic kingdoms respectively.

To mention but one more subject of M. Friedel's research, he has, in conjunction with Mr. J. M. Crafts, made out and defined a simple method of wide application for effecting the synthesis of organic compounds. This method consists in bringing together a hydrocarbon and an organic chloride in presence of chloride of aluminum, whereby the residues of the two compounds enter into combination to form a more complex, frequently a highly complex, body. Independently of its utility, this process of synthesis is of remarkable interest from the part taken in it by the chloride of aluminum, which, though essential to the reaction, is found unaltered at the end, and seems to act by suffering continuously, little by little, a correlative transformation and regeneration.

## UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The statutes made by the new Commissioners for the different colleges are appearing in their final shape. The statutes of six colleges are already printed and in the hands of Members of Convocation. They resemble each other closely in several respects. Ordinary Fellows are to be elected by examination, all the branches of learning recognised in the final schools of the University being taken from time to time as the subject of examination. These Fellowships are tenable for seven years. Tutorial Fellows are elected without examination, but the colleges may require two years' college work from an ordinary Fellow, having given notice of such requirement before the examination. The colleges may elect persons distinguished in literary or scientific work to Fellowships tenable for a term of years, during which the Fellows shall devote themselves to a definite research specified in the resolution appointing them.

Several meetings of the Professors and College Tutors engaged in teaching different branches of Physics in the University have been held during the last fortnight at the instance of Prof. Clifton. The object was to prepare a scheme of lectures for next term, such that the lecturers would cover most of the ground without clashing with each other or with the lecturers in other branches of science. It may be mentioned that this is the first time such an arrangement has been arrived at in the Natural Science School at Oxford. The following plan of lectures has been agreed upon for next Lent Term:—

Optics (treated Mathematically), Prof. Price, Tuesday, Thursday, and Saturday, at 12; Magnetism (treated experimentally), Prof. Clifton, Wednesday and Saturday, at 12; Practical Physics, Prof. Clifton, Mr. Stocker, Mr. Jones, daily, 11 a.m. to 4 p.m. Thermodynamics and Electrodynamics (treated mathematically), Mr. Baynes, Monday, Wednesday, and Friday, at 10; Electrostatics (treated mathematically), Mr. Hayes, Saturday at 11; Elementary Mechanics (treated experimentally), Mr. Stocker, Monday and Wednesday, at 10; Problems in Elementary Mechanics and Physics, Mr. Jones, Friday, at 10; Elementary Physics (treated experimentally), Mr. Dixon, Monday, Wednes-

day, and Friday, at 11. The last three courses of lectures are intended to meet the requirements of candidates for the Preliminary Honour Examination.

## SOCIETIES AND ACADEMIES

### London

**Geological Society**, November 17.—Robert Etheridge, F.R.S., president, in the chair.—Prof. Joseph Henry Thompson, Auckland, New Zealand, was elected a Fellow of the Society.—The President called attention to the portrait of Dr. William Smith, presented to the Society by his grand-nephew, Mr. W. Smith of Cheltenham, which was then suspended behind the chair, and expressed his great satisfaction at this most interesting picture being in possession of the Society. Mr. W. W. Smyth expressed the satisfaction which all must feel in possessing a genuine relic of this eminent stratigraphical geologist. Now this one, which had been so liberally presented to the Society, was a most indubitable portrait of the most conspicuous founder of English geology. That portrait was painted by M. Fouran in 1837, and was certainly an admirable likeness. The Society was deeply indebted to the donor, Mr. W. Smith, the cousin of the valued Prof. Phillips. The portrait now hanging on the wall was engraved in Prof. Phillips' "Life" of his uncle. He proposed a hearty vote of thanks to the donor. Mr. Evans rose with great pleasure to second the vote of thanks proposed by Mr. Warington Smyth. The portrait was indeed replete with interest, not only to English geologists, but to all geologists in the world. An additional interest attaching to the portrait was that we had the whole history of it from Dr. Smith's own hand, an extract from which Mr. Evans read. The portrait was an admirable one. He hoped that in the future Mr. Smith's example would be followed, and that we should see many other portraits of eminent geologists on the Society's walls. The Society was also deeply indebted to the president for the interest which he had taken in the matter. The vote of thanks was carried by acclamation.—The following communications were read:—On abnormal geological deposits in the Bristol district, by Charles Moore, F.G.S.—Interglacial deposits of West Cumberland and North Lancashire, by J. D. Kendall, C.E., F.G.S.

**Royal Microscopical Society**, November 10.—Dr. Beale, F.R.S., president, in the chair.—Photographs of *P. angulatum* and *Frustulia saxonica* were exhibited by Herr O. Brandt; the Tolles-Blackham and eight other microscopes by Mr. Crisp; "Calotte" diaphragms by Mr. Swift; Hyde's illuminator by Mr. J. Mayall, jun.; and Dr. Carpenter, C.B., described Wale's "working microscope" with Iris diaphragm, which he highly commended as combining many novel and excellent points for a student's microscope.—Mr. Lettsom described Abbe's "stereoscopic ocular," and Dr. Maddox his apparatus for collecting particles from the air.—Notes were read on monobromide of naphthaline (for mounting diatoms to increase their "index of visibility").—On ebonite for microscopical appliances, and on aperture exceeding 180° in air; also papers by Mr. Stewart on the echinometridæ, and by Dr. Royston Pigott on testing object-glasses.

### Paris

**Academy of Sciences**, November 22.—M. Edm. Becquerel in the chair.—The following papers were read:—Meridian observations of small planets at the Greenwich and Paris Observatories, communicated by M. Mouchez.—The thermal springs of the coast chain of Venezuela (South America), by M. Boussingault. The most important are those of Onoto (alt. 696 m.), Mariara (533m.), and Trincheras, near Nueva Valencia (300 to 350m.). The respective temperatures are 44°·5, 64°·0, and 96°·9, showing an increase proportional to the decrease in altitude, 1° for a difference of level of 6m. to 7m. After the springs of Urijino, Japan (100°), those of Trincheras are probably the hottest. The author gives an analysis of their water; also general descriptions of the others.—*Reconnaissance* of the Napo (Equatorial America), by M. de Lesseps. This important affluent of the Amazon has been scientifically explored by M. Wiener, who in seven months has crossed South America in its greatest width, Quito to Para. The river is navigable a thousand miles from its entrance to the Amazon. He indicates a region larger than France well suited for colonisation.—On the treatment of vines with sulphide of carbon, by M. de Lafitte.—On the simultaneous reduction of a quadratic form and of a linear form, by M. Poincaré.—On Leverrier's tables of the motion of Saturn, by M. Gaillot.—On a property of the polynômes $X_n$ of Legendre, by M. Laguerre.—New tables for calculating heights by means of barometric observations, by M. Angot. These tables give directly the height of each station above the level where the pressure is 760mm.; this is near the true altitude, an idea of which may thus be had without comparing results from two stations. The exactness is at least as great as with the best formulæ proposed. The heights calculated differ always from the real height in a sense that can be known *à priori*.—Researches on sulphide of nitrogen, by M. Demarcay.—On phytolaccic acid, by M. Terreil. This new organic acid exists in the state of a salt of potash in the fruit of *Phytolacca Kæmpferi*. (Its properties are described.)—Measurement of the toxical dose of carbonic oxide in different animals, by M. Gréhant. Great differences were observed: a mixture of $\frac{1}{800}$ strength was the poisonous dose for one dog, $\frac{1}{250}$ for another (the animals being made to breathe 200 litres). A rabbit required $\frac{1}{80}$ (breathing 50 litres). The smallest sufficing dose was that for a sparrow, $\frac{1}{800}$.—On a new species of *Poroxylon*, by M. Renault. This plant is named *P. Edwardsii*. The *Poroxyleæ* are found in the Upper Coal and Permian formations.—Transformation of a fructiferous ramification, resulting from fertilisation, into a prothalliform vegetation, by M. Sirodot. This was observed in *Batrachospermum vagum* (Roth).—Influence of light on the respiration of seeds during germination, by M. Pauchon. These experiments were made on the castor-oil plant (as being oleaginous and albuminous) and on the haricot bean (feculent and without albumen). As in previous experiments, a good deal more O was observed in light than in darkness. The castor-oil seeds exhale slightly more $CO_2$ in darkness than in light, but the opposite was the case with the seed of *Phaseolus*. In darkness the ratio of $CO_2$ to O was for the haricot at least $\frac{1}{3}$ superior to that for the castor-oil plant, but prolongation of the experiment tends to bring the relation equal to unity, whatever the original value. For a given quantity of oxygen absorbed the seed placed in darkness exhales more $CO_2$ than that kept in light. While in light there is always less $CO_2$ exhaled than O absorbed, the contrary occurs in darkness. These facts explain the transformation of legumin into asparagin.—Observations on the *rôle* attributed to maize, used as food, in the production of pellagra, by M. Fua. He considers M. Faye's opinion, that pellagra may be caused by the large use of unfermented maize, to be in contradiction with facts. Maize is always eaten in the unfermented state. It forms the chief food of a large population in Central Africa, where pellagra does not occur; and similarly in Naples and in Hungary. He refers to certain alterations of maize (by fungi and oxidation).

### Vienna

**Imperial Academy of Sciences**, December 2. Dr. L. A. Fitzinger in the chair.—On the theory of so-called electric expansion or electrostriction; Part ii., by Dr. Boltzmann.—Calculation of the absolute value and determination of the general equation of electrostriction, by the same.—On some properties of bromide of ammonium, by Dr. Eder.—Observations on contact-electricity (sealed packet), by Herr Schulze-Berge.—Results of an investigation of the identity of the comets 1880 *e* and 1869 III., by Herr Zelber and Dr. Hepperger.—On graphic formulæ of hydrocarbons with condensed benzol-nuclei, by Herr Wegscheider.

## CONTENTS